BP Products North America Inc.
2815 Indianapolis Blvd.
P.O. Box 710
Whiting, IN 46394-0710
USA

June 27, 2016

Director, Air Enforcement Division
Office of Civil Enforcement (2242A)
Office of Enforcement and Compliance Assurance
United States Environmental Protection Agency
1200 Pennsylvania Ave., N.W.
Washington, DC 20004

Compliance Tracker (AE-17J)
Air Enforcement and Compliance Assurance branch
U.S. EPA, Region 5
77 W. Jackson Blvd.
Chicago, IL 60604

Office of Regional Counsel
U.S. EPA, Region 5
77 West Jackson Blvd. (C-14J)
Chicago, IL 60604

Re: **United States, et.al. v. BP Products North America Inc.**
Northern District of Indiana, Hammond Division
Civil Action No. 2:12 CV 207
First Updated Waste Gas Minimization Plan

As required by Appendix D, ¶ 19 of the BP Whiting Consent Decree (CD), BP is submitting the First Updated Waste Gas Minimization Plan (WGMP) for each Covered Flare, discussing and evaluating flaring prevention measures both refinery-wide and on a flare-specific basis.

If you require additional information, please contact Ken Taylor at 219-370-3310.

Sincerely,

Linda Wilson

Linda Wilson
Environmental Manager
BP Whiting Business Unit

Attachment

E-mail distribution:
csullivan@matrixneworld.com
foley.patrick@epa.gov
loukeris.constantinos@epa.gov
Whiting.CD.Tracker@bp.com

Submitted hard-copy:

cc w/o attachment:

Chief
Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice
P.O. Box 7611
Ben Franklin Station
Washington, DC 20044-7611
Reference Case No. 90-5-2-1-09244

cc w/ attachment:

Office of the Indiana Attorney General
Environmental Litigation Division
Indiana Government Center South- Fifth Floor
302 West Washington Street
Indianapolis, IN 46204

Chief, Air Compliance and Enforcement Branch
Indiana Department of Environmental Management
100 North Senate Avenue
MC 61-53, IGCN 1003
Indianapolis, IN 46204-2251

Director, Air Enforcement Division
Office of Civil Enforcement
c/o Matrix New World Engineering, Inc.
120 eagle Rock Ave., Suite 207
East Hannover, NJ 07936-3159
Washington, DC 20004

First Updated Waste Gas Minimization Plan

BP Products North America
Whiting Refinery

Revision 0

June 2016

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

EXECUTIVE SUMMARY

In the past, BP Products North America's (BPP's) Whiting Refinery has achieved reductions in flare emissions through the implementation of work practices and equipment reliability programs designed to minimize the need to send Waste Gas to flare. Additionally, flare monitoring and efficacy measures have been implemented to further increase flare effectiveness and reduce emissions. Specifically, these measures include the installation of flow monitoring devices (i.e., volumetric flow meters, gas chromatograph units, etc.) and integrated steam controllers. This Waste Gas Minimization Plan (WGMP) was created to describe the general procedures that BPP will employ to minimize flaring events in the future.

The goal of this WGMP is to describe procedures to be implemented at the Whiting Refinery to reduce the frequency of flaring events, reduce the volume of Vent Gas generated during flaring events, and increase Vent Gas quality. An evaluation of historical flaring events and actions taken to help control the volume of Vent Gas sent to flare at the facility is provided herein. The WGMP provides data that are used to evaluate progress in reducing flaring events and Vent Gas flow. It details the procedures to be used to continually improve on the goal of reducing emissions from flaring.

The Initial WGMP submitted in June 2015 has been updated according to the requirements of Paragraph 19 in Appendix D of the Consent Decree between the United States and BP Products North America (Consent Decree), case number 2:12-CV-00207-PPS-APR, entered with the United States District Court for the Northern District of Indiana (Hammond Division) on November 6, 2012. The primary changes include a review of Root Cause Analysis (RCA) reports for potential further waste gas reductions, and revised baseload waste gas flow rates for covered flares not tied into flare gas recovery systems based on data from the 2015 calendar year.

SECTION 1
INTRODUCTION

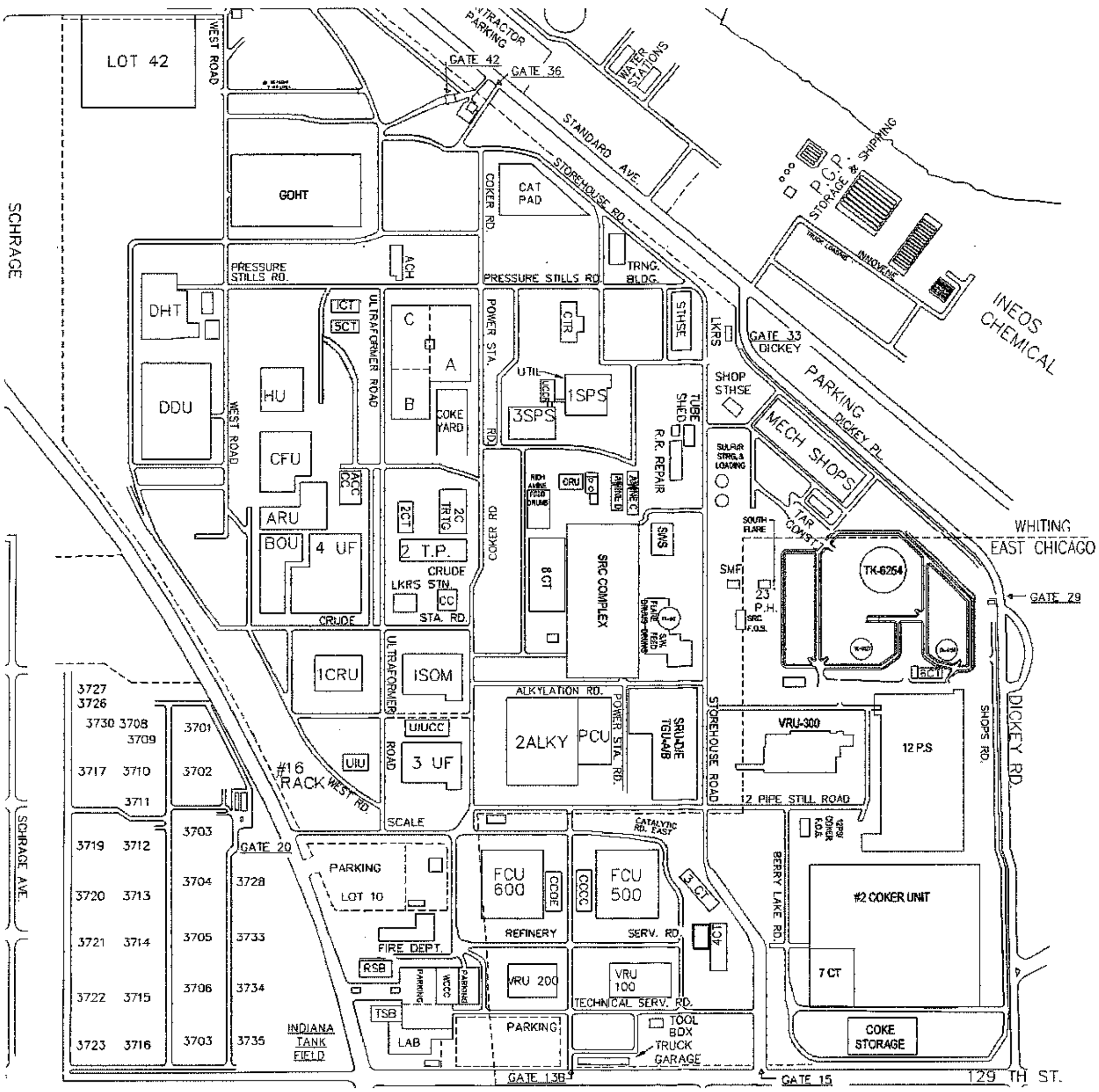
BP Products North America Inc. (BPP) operates the Whiting Refinery located at 2815 Indianapolis Blvd, Whiting, Indiana. The facility refines crude oil into various petroleum products and is organized into several groups of process units designed to maximize the production of transportation fuels. Figure 1-1 shows the Whiting Refinery layout. The refining process utilizes physical and chemical reactions which require increased temperatures and/or pressures. Critical elements of most process equipment are pressure relief devices used to ensure process equipment do not become over-pressurized and create a safety hazard. To limit the emission of hydrocarbon constituents from these relief devices, they are collected in a header system and processed in a safe manner in a refinery flare system. Refinery flares are designed to accept a broad range of gas flow rates and compositions which may result from emergency conditions or small leaks in relief devices. Flare systems vary greatly depending on the application and specific conditions present in the process units having connections to the flare header system.

Every flare system consists of a relief gas header system, otherwise referred to as "flare header system" or "Waste Gas header system", which provides a controlled outlet for any excess vapor flow. Each relief gas header has connections to depressurization and purging relief devices related to maintenance turnaround, startup, and shutdown, as well as other pressure relief devices and safety control devices to handle emergency situations. Typically, relief gas header systems incorporate a knockout drum for separation of liquids entrained in the Waste Gases. Liquids can cause damage to flare systems and create a serious safety concern. Liquids from the knockout drum are sent for treatment and then recycled back into the refinery process. Gases are routed to the flare tip or to flare gas recovery devices.

Keeping air from leaking into the system is critical to preventing excess oxygen from entering the relief flare header. This is typically accomplished by maintaining a slightly positive pressure in the header via the use of a liquid seal at a point prior to the flare tip. A liquid seal creates a barrier to uninterrupted flow which must be overcome prior to having gas flow to the flare tip. Additionally, it isolates the flare tip, a potential source of ignition, from the header system and the rest of the process unit. Alternatively, a gas may be used to constantly purge the header system to maintain a positive pressure in the header. A velocity seal may be installed at the base of the flare tip to limit the amount of Purge Gas required to prevent backflow.

Gas exits the flare via a tip which is specially designed to promote combustion over a range of flow rates and reduce noise. Steam is used to increase mixing at the flare tip, improve combustion efficiency, and reduce smoking. Natural gas is used as Pilot Gas at the flare tip to keep a pilot light burning, to provide a positive pressure at the flare tip to promote upward flow, and to help increase the Net Heating Value (NHV) as Supplemental Gas, if flare gas has low BTU content. Properly designed and operated flare systems can achieve greater than 98 percent combustion efficiency, producing mainly carbon dioxide (CO_2) and water. Other compounds may be present depending on the source of the flow to the flare. For example, sulfur dioxide (SO_2) may be present if there are sulfur-containing compounds present in the flare gas.

Figure 1-1 Whiting Refinery Plot Plan



1.1 Whiting Refinery Flare System

Flare systems are essential refinery safety equipment used to combust gases that would otherwise be released to the environment. Without the combustion that flares are designed to provide, potentially dangerous gases could be released, creating a health hazard to workers and refinery neighbors. Additionally, released gases create a fire hazard if not properly handled and controlled through a flare system. The gases handled by flare systems are released from relief valves, pump seals, and many other devices designed to keep the refinery safe and reduce fugitive emissions.

The Whiting Refinery has eight (8) Covered Flares which are subject to this Waste Gas Minimization Plan (WGMP). These flares are the Vapor Recovery Unit (VRU), Fluidized Catalytic Cracking Unit (FCU), Alkylation (Alky), #4 Ultraformer (4UF), Ultraformate Isomerization Ultrafining (UIU), South, Gas-Oil Hydrotreater (GOHT), and Distillate Desulfurization Unit (DDU) Flares.

Each flare was designed to serve specific process units in the refinery with various quantities and compositions of Waste Gas being routed to them.

1.2 Waste Gas Minimization Plan Requirements

This WGMP was prepared to discuss and evaluate flaring preventive measures both Refinery-wide and on a flare-specific basis. It was prepared to comply with the requirements of Paragraphs 18-21 in Appendix D of the Consent Decree. In accordance with the Consent Decree, this WGMP is due June 30, 2015. An evaluation of the effectiveness of and revision to the initial WGMP must be made within 12 months following implementation of the initial WGMP and annually thereafter. It must also be updated following any change to the information, diagrams, and drawings provided in the Flare Data and Monitoring Systems and Protocol Report required under Paragraph 5 in Appendix D of the Consent Decree. In addition, this WGMP will be used in conjunction with the Flare Management Plans (FMPs) that have been prepared for the Covered Flares by complying with 40 CFR 60 Subpart Ja per Paragraph 22 in Appendix D of the Consent Decree.

The Consent Decree stipulates that the elements of the initial WGMP include:

- If and as necessary, updates to the information submitted in the Flare Data and Monitoring Systems and Protocol Report;
- The volumetric and mass flow rates, in scfm and lb/hr, respectively, of Waste Gas sent to each Covered Flare over the period from January 1, 2014 through December 31, 2014, on a 30-day rolling average;
- The baseload Waste Gas flow rate, in scfd, to each Covered Flare, excluding South Flare and GOHT. The baseload calculation will exclude periods of Startup, Shutdown, and Malfunction. The baseload flow rate for the initial WGMP covered the period from January 1, 2014 through December 31, 2014;
- Information regarding the percentage contribution of each constituent gas within each Covered Flare's Waste Gas baseload;

- Information regarding tie-in connections to each process unit and main flare header systems, excluding temporary connections;
- A description of the equipment, processes, and procedures installed or implemented to reduce flaring events over the reporting period of 2012 – 2014;
- Identification of equipment, processes, and procedures that BPP plans to install or implement to reduce flaring events in the future, along with a schedule for completion of these plans and a projection of the amount of reductions to be realized;
- Identification of any flares that will be taken out of service and schedule for completion of decommissioning; and
- Evaluation of the preventive measures and an implementation schedule to address the following:
  - Flaring that has occurred or could occur during maintenance activities (including shutdown and startup) from 2012 – 2014 and the feasibility to perform these activities without flaring;
  - Flaring that may occur due to issues of gas quantity and quality; and
  - Flaring caused by recurrent failure (e.g. same root cause that occurs more than twice during any five year period) of air pollution control devices, process equipment, or processes that fail to operate in a normal or usual manner by reviewing adequacy of existing equipment maintenance schedules and protocols.

The Consent Decree stipulates that the elements of the First Updated WGMP include:

- Updates for the preceding calendar year;
- If and as necessary, BPP shall update the Waste Gas mapping as more information becomes available. BPP shall use this updated mapping to plan reductions;
- If and as necessary, BPP shall review all of the Root Cause Analysis reports prepared pursuant to Paragraph 54 of the CD to determine if reductions in addition to the reductions achieved through any corrective action under Paragraph 55 of the CD can be realized; and
- To the extent that BPP proposed to extend any schedule set forth in the Initial WGMP, BPP shall do so only with good cause.

The Consent Decree defines the following terms as they pertain to the WGMP:

- "Hydrocarbon Flaring Incident" or "HC Flaring Incident" shall mean either of the following:
  i. "HC Flaring Incident – Trigger 1": the continuous or intermittent combustion of refinery-generated gases, except for Acid Gas, Sour Water Stripper Gas, or Tail Gas, at a Hydrocarbon Flare that results in the emission of sulfur dioxide equal to or greater than five-hundred (500) pounds in any 24-hour period; provided, however, that if 500 pounds or more of sulfur dioxide has been emitted in any 24-hour period and flaring continues into subsequent, contiguous, non-overlapping 24-hour

period(s), each period of which results in emissions equal to, or in excess of, 500 pounds of sulfur dioxide, then only one HC Flaring Incident shall have occurred. Subsequent, contiguous, non-overlapping periods are measured from the initial commencement of Flaring within the HC Flaring Incident. When HC Flaring occurs within a 24-hour period at more than one HC Flare, the quantity of sulfur dioxide attributable to HC Flaring emitted from each HC Flare shall be added together for purposes of determining whether there is one HC Flaring Incident, unless the root causes of the flaring at the various HC Flaring Devices are not related to each other; or

ii. "HC Flaring Incident – Trigger 2": the combustion of 500,000 standard cubic feet or more of Waste Gas (excluding Acid Gas, Sour Water Stripper Gas, and Tail Gas) within a 24-hour period at a Hydrocarbon Flare. For purposes of calculating Waste Gas flow rate, the following flows may be excluded: (i) the pro-rated Baseload Waste Gas Flow Rate (pro-rated on the basis of the duration of the Flaring Incident); and (ii) if BPP has instrumentation capable of measuring the volumetric flow rate of hydrogen, nitrogen, oxygen, carbon monoxide, carbon dioxide, and/or steam in the Waste Gas, the contribution of all measured flows of any of these elements/compounds. Subsequent, contiguous, non-overlapping periods are measured from the initial commencement of Flaring within the HC Flaring Incident. When HC Flaring occurs within a 24-hour period at more than one HC Flare, the volume of Waste Gas attributable to HC Flaring emitted from each HC Flare shall be added together for purposes of determining whether there is one HC Flaring Incident, unless the root causes of the flaring at the various HC Flaring Devices are not related to each other.

- "Pilot Gas" shall mean all gas introduced through the pilot tip of a Flare to maintain a flame.
- "Purge Gas" shall mean the minimum amount of gas introduced between a Flare header's water seal and the Flare tip to prevent oxygen infiltration (backflow) into the Flare tip. For a Flare with no water seal, the function of Purge Gas is performed by Sweep Gas, and therefore, by definition, such a Flare has no Purge Gas.
- "Sweep Gas" shall mean:
  - For a Flare with a Flare Gas Recovery System: the minimum amount of gas introduced into a Flare header in order to: (a) prevent oxygen buildup, corrosion, and/or freezing in the Flare header; and (b) maintain a safe flow of gas through the Flare header. Sweep Gas in these Flares is introduced prior to and is intended to be recovered by the Flare Gas Recovery System;
  - For a Flare without a Flare Gas Recovery System: the minimum amount of gas introduced into a Flare header in order to: (a) prevent oxygen buildup, corrosion, and/or freezing in the Flare header; (b) maintain a safe flow of gas through the Flare heater; and (c) prevent oxygen infiltration (backflow) into the Flare tip.
- "Supplemental Gas" shall mean all gas introduced to a Flare to comply with the net heating value requirements of 40 C.F.R. § 60.18(b), 40 C.F.R. § 63.11(b), and/or Paragraph 33 of this Appendix.

- "Vent Gas" shall mean the mixture of all gases found prior to the Flare tip. This gas includes all Waste Gas, Sweep Gas, Purge Gas, and Supplemental Gas, but does not include Pilot Gas, Total Steam, or Assist Air.
- "Waste Gas" shall mean the mixture of all gases from facility operations that is directed to a flare for the purpose of disposing of the gas. "Waste Gas" does not include gas introduced to a flare exclusively to make it operate safely and as intended; therefore, "Waste Gas" does not include Pilot Gas, Total Steam, Assist Air, or the minimum amount of Sweep Gas and Purge Gas that is necessary to perform the functions of Sweep Gas and Purge Gas. "Waste Gas" also does not include gas introduced to a flare to comply with regulatory requirements; therefore, "Waste Gas" does not include Supplemental Gas.

In order to conform to the requirement to provide information regarding tie-in connections to each process unit and flare header, Table 1-1, below, summarizes the process units and ancillary equipment connections to each flare header.

Table 1-1
Process Units and Ancillary Equipment Connected to Flare Headers

Flare	Unit	Equipment	Type of Equipment
VRU	VRU-100	PRVs	Process Unit
	VRU-200	PRVs	Process Unit
	FCU 500	PRVs	Process Unit
		J-3D	Wet Gas Compressor
		J-3G	Wet Gas Compressor
	VRU-300	PRVs	Process Unit
		D-400	Off-Gas Knock-Out Drum
		K-340/K-351	Wet Gas Compressor
FCU	FCU 600	PRVs	Process Unit
		J-3D	Wet Gas Compressor
		J-3E	Wet Gas Compressor
ALKY	Alky	PRVs	Process Unit
		D-22	Off-Gas Knock-Out Drum
		D-13	Spent Acid Stripper Drum
		D-32	Spent Caustic Drum
	PCU	PRVs	Process Unit
		D-100	Caustic Degassing Drum
4UF	4UF	PRVs	Process Unit
		D-3/4/5/6/7/8	Catalyst-Filled Reactors
	BOU	PRVs	Process Unit
	ARU	PRVs	Process Unit

Flare	Unit	Equipment	Type of Equipment
UIU	Isom	PRVs	Process Unit
		Isom D-18	Flare Knock-Out Drum
	CRU	PRVs	Process Unit
South	VRU-300	PRVs	Process Unit
	12PS	PRVs	Process Unit
	Coker 2	PRVs	Process Unit
		K-401	Wet Gas Compressor
	SRC	PRVs	Process Unit
		TGU-A	Tail Gas Unit
		TGU-B	Tail Gas Unit
	VRU-400	PRVs	Process Unit
GOHT	GOHT	PRVs	Process Unit
DDU	11A Pipestill	PRVs	Process Unit
	11C Pipestill	PRVs	Process Unit
	DDU	PRVs	Process Unit
	DHT	PRVs	Process Unit

BPP currently has no plans for the removal of any Covered Flares from service. Future revisions of this document will include the required details if any Covered Flares become scheduled for decommissioning.

It should be noted that several of the flaring systems are configured to allow for rerouting units in one flare's area to another flare during flare shutdown and turnaround events. While normally operated as separate systems, the interconnected flare pairings include the FCU and VRU Flares, the GOHT and DDU Flares, as well as the 4UF and UIU Flares. Further details are provided in Table 1-1 and each corresponding flare section in Section 2.

SECTION 2
FLARE SYSTEMS INFORMATION

2.1 VRU Flare

2.1.1 Flare Management Plan Provisions of the NSPS Subpart Ja

As of December 31, 2015, the VRU Flare is subject to the Flare Management Plan provisions of the NSPS Subpart Ja. BPP will comply with the most recent version of the NSPS Subpart Ja Flare Management Plan for the VRU Flare from that date forward, in addition to any non-overlapping provisions in Paragraphs 18-21 and 43 of the CD.[1]

2.1.2 Equipment and Controls

The VRU Flare is a steam-assisted, elevated flare that was constructed in 1945. The flare header system for the VRU Flare collects and delivers Vent Gases from the FCU 500 (which contains J-3D and J-3G), FCU 600 (which contains J-3D and J-3E), VRU 100, VRU 200, and VRU 300 (which contains D-400, K-340, and K-351) units. FCU 600 is typically routed to the FCU Flare, but also has a connection to allow Vent Gases to be routed to the VRU Flare in the event that the FCU Flare is temporarily down, such as in a turnaround situation. FCU 500 is typically routed to the VRU Flare, but, through the same connection, Vent Gases can be routed to the FCU Flare in the event that the VRU Flare is temporarily down, such as in a turnaround situation. Gases which are vented from these areas, either from system over-pressurization caused by a malfunction or any other reason, flow into the VRU Flare Knockout Drums (F-111 and F-211) and, ultimately, the flare tip.

The VRU Flare has two knockout drums, which are designed to separate and collect liquid from a Waste Gas stream and ensure that only gas is sent to the flare tip. Drum F-111 handles flare header gas from VRU 100, and F-211 handles flare header gas from VRU 200 and VRU 300 with an existing infrastructure connection to handle the FCU 600, which is separated by a normally closed isolation valve. The remaining liquid is recycled back into the refinery process via knockout drum pumps. Sources entering the flare header system will flow to the knockout drums for liquid separation before being sent to the flare stack for combustion.

The VRU Flare is identified as S/V 241-01 in the Refinery. The flare stack stands 200 feet above the ground surface and has a flare tip diameter of 24 inches. The flare tip is model 24" NFF-RC-HS, manufactured by NAO, and was last replaced in December 2004. The system contains a total of three 1" pilot lights. An ignition system containing three 1" explosion and weather proof ignition tubes utilizing Flame Front Generator (FFG) ignition provides the energy to cause the desired combustion of the Pilot Gas.

[1] Note, the original VRU FMP was submitted to U.S. EPA on December 30, 2015, pursuant to 40 CFR 60.103a(b).

A series of monitoring instruments including Waste Gas, Purge Gas, and steam flow meters and a gas chromatograph (GC) analyze the inputs to the flare header prior to the flare tip. The Waste Gas flow reading, along with information regarding composition from the GC, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. The design of the flare permits adjusting the amount of steam, allowing the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. >98%). Additionally, recording flow rates and compositions allows BPP to evaluate the potential sources of flow more accurately and develop strategies for eliminating or reducing Waste Gas flow.

2.1.3 Waste Gas Volumetric and Mass Flow Rates

The Waste Gas volumetric and mass flow rates can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The volumetric flow rate of the Vent Gas can be derived by an ultrasonic flow meter by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric and mass flow rates by determining the composition of the Vent Gas so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The average Waste Gas and Vent Gas flow rates for the VRU Flare (found below in Tables 2-1 and 2-2) were determined using data collected between January 1, 2015 and December 31, 2015, excluding periods of downtime.

Table 2-1
VRU Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
153.5	579.2

Table 2-2
VRU Flare Vent Gas and Waste Gas Volumetric Flow Rates

Vent Gas Volumetric Flow Rate (scfd)	Waste Gas Volumetric Flow Rate (scfd)
1,109,242	217,092

2.1.4 Baseload Waste Gas Flow Rate

The VRU Flare is connected to the Flare Gas Recovery System 3 (FGRS 3) as of December 31, 2015. Therefore, the baseload Waste Gas flow rate is effectively zero.

2.1.5 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-3 shows composition data that is typical for the VRU Flare for the time between January 1, 2015 and December 31, 2015, excluding periods of downtime.

Table 2-3
VRU Flare Baseload Constituents

Component	Average Mole %
Nitrogen	59.08
Oxygen	0.15
Water/Steam	0.93
Carbon Dioxide	1.42
Carbon Monoxide	0.30
Hydrogen	3.48
Hydrogen Sulfide	0.02
Methane	18.36
Ethane	4.46
Ethylene	5.53
Acetylene	0.00
Propane	1.05
Propylene	2.15
iso-Butane	0.27
n-Butane	0.43
C_4 Olefins	0.25
C_5H_{12}	1.23

2.1.6 Waste Gas Mapping

Waste Gas mapping of FCU 500, FCU 600, VRU 100, VRU 200, and VRU 300 units was performed through the use of engineering analysis. Data from the ultrasonic flow meter was used to determine the total flow through the flare header. Sweep Gas rates were determined by using rotameter data, and the Waste Gas contributions of individual unit headers were determined using estimates from BPP process engineers and process instrumentation diagrams. The resulting block flow diagram (BFD) of the overall flare layout is provided in Attachment A. It is of note that these flows are only a snapshot in time and can possibly change depending on process unit events.

There was no updated Waste Gas mapping performed in 2015; therefore, there are no updates in the First Updated Waste Gas Minimization Plan.

2.1.7 Past Emission Reductions

Provided below in Table 2-4, is a list of preventive measures completed over the past 4 years. These reductions represent a good-faith effort by BPP to reduce flaring prior to the requirements of the Consent Decree. Where possible, an estimate of the reduction is provided. Subsequent updates to this document will list all previously completed or implemented actions conducted prior to the revision date.

Table 2-4
VRU Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2015	Install and commence operation of Flare Gas Recovery System 3, in accordance with the requirements of the BP Whiting Consent Decree.	217 MSCFD*
2013	Sweep Gas Rotameter Study conducted to identify minimum Sweep Gas rate required for prevention of backflow resulting from thermal contraction	NA
2013	Initial Pressure Relief Valve Leak Survey	NA
2012 – Present	Monthly Preventative Maintenance Rounds conducted by Operations to identify leaking PRVs	NA

*Flare Gas Recovery will also absorb some portion of contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

2.1.8 Flare Specific Planned Reductions

Pursuant to the requirements set forth in the Consent Decree, BPP reviewed potential future preventive measures. The installation and operation of the Flare Gas Recovery System 3 was the primary planned reduction from the Initial Waste Gas Minimization Plan, and has been implemented per Table 2-4.

2.1.9 Root Cause Analysis Review

Pursuant to the requirements set forth in the Paragraph 19.b of the CD, BPP shall review all of the Root Cause Analysis reports prepared in order to determine if additional reductions can be achieved through any corrective action(s). There have been a total of two (2) RCA reports unique to the VRU Flare between the date of entry and December 31, 2015 pursuant to Paragraph 54 of the CD. The April 29, 2013 event and the May 9, 2013 event were shown to originate from different causes. The June 20, 2013 event affected both the VRU and UIU Flares, and the November 21, 2013 event caused flaring at the GOHT Flare, 4UF Flare, UIU Flare, and VRU Flare. As the VRU flare is now connected to the Flare Gas Recovery System 3, there is no further potential for waste gas reductions. .

2.2 FCU Flare

2.2.1 Flare Management Plan Provisions of the NSPS Subpart Ja

As of December 31, 2015, the FCU Flare is subject to the Flare Management Plan provisions of the NSPS Subpart Ja. BPP will comply with the most recent version of the

NSPS Subpart Ja Flare Management Plan for the FCU Flare from that date forward, in addition to any non-overlapping provisions in Paragraphs 18-21 and 43 of the CD.[2]

2.2.2 Equipment and Controls

The FCU Flare is a steam-assisted, elevated flare that was constructed in 1945. The flare header system for the FCU Flare collects and delivers Vent Gases from the FCU 500 (which contains J-3D and J-3G) and FCU 600 (which contains J-3D and J-3E) units. FCU 600 is typically routed to the FCU Flare, but also has a connection to allow Vent Gases to be routed to the VRU Flare in the event that the FCU Flare is temporarily down, such as in a turnaround situation. FCU 500 is typically routed to the VRU Flare, but, through the same connection, Vent Gases can be routed to the FCU Flare in the event that the VRU Flare is temporarily down, such as in a turnaround situation. Gases which are vented from these areas, either from system over-pressurization caused by a malfunction or any other reason, flow into the FCU Flare Knockout Drum (F-25) and, ultimately, the flare tip.

The FCU Flare has one knockout drum, which is designed to separate and collect liquid from a Waste Gas stream and ensure that only gas is sent to the flare tip. The remaining liquid is recycled back into the refinery process via knockout drum pumps. Sources entering the flare header system will flow to the knockout drum for liquid separation before being sent to the flare stack for combustion.

The FCU Flare is identified as S/V 230-02 in the Refinery. The flare stack stands 200 feet above the ground surface and has a flare tip diameter of 24 inches. The flare tip is model 24" NFF-RC-HS, manufactured by NAO, and was last replaced in August 2008. The system contains a total of three 1.25" pilot lights. An ignition system containing three 1" explosion and weather proof ignition tubes utilizing Flame Front Generator (FFG) ignition provides the energy to cause the desired combustion of the Pilot Gas.

A series of monitoring instruments including Waste Gas, Purge Gas, and steam flow meters and a gas chromatograph (GC) analyze the inputs to the flare header prior to the flare tip. The Waste Gas flow reading, along with information regarding composition from the GC, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. The design of the flare permits adjusting the amount of steam, allowing the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. >98%). Additionally, recording flow rates and compositions allows BPP to evaluate the potential sources of flow more accurately and develop strategies for eliminating or reducing Waste Gas flow.

2.2.3 Waste Gas Volumetric and Mass Flow Rates

The Waste Gas volumetric and mass flow rates can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The volumetric flow rate of the Vent Gas can be derived by an ultrasonic flow meter by determining the Vent

[2] Note, the original FCU FMP was submitted to U.S. EPA on December 30, 2015, pursuant to 40 CFR 60.103a(b).

Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric and mass flow rates by determining the composition of the Vent Gas so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The average Waste Gas and Vent Gas for the FCU Flare (found below in Tables 2-5 and 2-6) were determined using data collected between January 1, 2015 and December 31, 2015, excluding periods of downtime, as well as downtime of the VRU Flare when normal waste gas flows sent to the VRU Flare were rerouted to the FCU Flare.

Table 2-5
FCU Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
99.6	283.6

Table 2-6
FCU Flare Vent Gas and Waste Gas Volumetric Flow Rates

Vent Gas Volumetric Flow Rate (scfd)	Waste Gas Volumetric Flow Rate (scfd)
773,758	147,135

2.2.4 Baseload Waste Gas Flow Rate

The FCU Flare is connected to the Flare Gas Recovery System 3 (FGRS 3) as of December 31, 2015. Therefore, the baseload Waste Gas flow rate is effectively zero.

2.2.5 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-8 shows composition data that is typical for the FCU Flare for the time between January 1, 2015 and December 31, 2015.

Table 2-8
FCU Flare Baseload Constituents

Component	Average Mole %
Nitrogen	44.75
Oxygen	1.25
Water/Steam	0.48
Carbon Dioxide	2.13
Carbon Monoxide	0.21
Hydrogen	5.54
Hydrogen Sulfide	0.00
Methane	18.88
Ethane	7.16
Ethylene	9.06
Acetylene	0.00
Propane	0.85
Propylene	2.78
iso-Butane	0.33
n-Butane	0.06
C_4 Olefins	0.20
C_5H_{12}	0.40

2.2.6 Waste Gas Mapping

Waste Gas mapping of FCU 500 and FCU 600 units was performed through the use of engineering analysis. Data from the ultrasonic flow meter was used to determine the total flow through the flare header. Sweep Gas rates were determined by using rotameter data, and the Waste Gas contributions of individual unit headers were determined using estimates from BPP process engineers and process instrumentation diagrams. The resulting block flow diagram (BFD) of the overall flare layout is provided in Attachment B. It is of note that these flows are only a snapshot in time and can possibly change depending on process unit events.

2.2.7 Past Emission Reductions

Provided below in Table 2-9, is a list of preventive measures completed over the past 4 years. These reductions represent a good-faith effort by BPP to reduce flaring prior to the requirements of the Consent Decree. Where possible, an estimate of the reduction is provided. Subsequent updates to this document will list all previously completed or implemented actions conducted prior to the revision date.

Table 2-9
FCU Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
December 2015	Install and commence operation of Flare Gas Recovery System 3, in accordance with the requirements of the BP Whiting Consent Decree.	99 MSCFD*
2013	Sweep Gas Rotameter Study conducted to identify minimum Sweep Gas rate required to prevent backflow resulting from thermal contraction	NA
2013	Initial Pressure Relief Valve Leak Survey	NA
2012 – Present	Monthly Preventative Maintenance Rounds conducted by Operations to identify leaking PRVs	NA

*Flare Gas Recovery will also absorb some portion of emissions contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

2.2.8 Flare Specific Planned Reductions

Pursuant to the requirements set forth in the Consent Decree, BPP reviewed potential future preventive measures. The installation and operation of the Flare Gas Recovery System 3 was the primary planned reduction from the Initial Waste Gas Minimization Plan, and has been implemented per Table 2-9.

2.2.9 Root Cause Analysis Review

Pursuant to the requirements set forth in the Paragraph 19.b of the CD, BPP shall review all of the Root Cause Analysis reports prepared in order to determine if additional reductions can be achieved through any corrective action(s). There were no RCA reports prepared for the FCU Flare between the date of entry and December 31, 2015 pursuant to Paragraph 54 of the CD.

2.3 Alky Flare

2.3.1 Equipment and Controls

The Alky Flare is a steam-assisted, elevated flare that was constructed in 1961. The flare header system for the Alky Flare collects and delivers Vent Gases from the Alky (which contains, D-13, D-22, and D-32), GDU, PCU (which contains D-100), and SRU units. Gases which are vented from these areas, either from system over-pressurization caused by a malfunction or any other reason, flow into the Alky Flare Knockout Drum (D-22) and, ultimately, the flare tip.

The Alky Flare has one knockout drum, which is designed to separate and collect liquid from a Waste Gas stream and ensure that only gas is sent to the flare tip. The remaining liquid is recycled back into the refinery process via knockout drum pumps. Sources entering the flare header system will flow to the knockout drum for liquid separation before being sent to the flare stack for combustion.

The Alky Flare is identified as S/V 140-01 in the Refinery. The flare stack stands 199.5 feet above the ground surface and has a flare tip diameter of 30 inches. The flare tip is model 30-NFF-RC-HS, manufactured by NAO, and was last replaced in September 2006. The system contains a total of three 3/4" pilot lights. An ignition system containing three 1" explosion and weather proof ignition tubes provides the energy to cause the desired combustion of the Pilot Gas.

A series of monitoring instruments including Waste Gas, Purge Gas, and steam flow meters and a gas chromatograph (GC) analyze the inputs to the flare header prior to the flare tip. The Waste Gas flow reading, along with information regarding composition from the GC, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. The design of the flare permits adjusting the amount of steam, allowing the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. >98%). Additionally, recording flow rates and compositions allows BPP to evaluate the potential sources of flow more accurately and develop strategies for eliminating or reducing Waste Gas flow.

2.3.2 Waste Gas Volumetric and Mass Flow Rates

The Waste Gas volumetric and mass flow rates can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The volumetric flow rate of the Vent Gas can be derived by an ultrasonic flow meter by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric and mass flow rates by determining the composition of the Vent Gas so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The Waste Gas volumetric and mass 30 day average flow rates for the Alky Flare (found below in Table 2-11) were determined using data collected between January 1, 2015 and December 31, 2015.

Table 2-11
Alky Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
182.1	1,143.1

2.3.3 Baseload Waste Gas Flow Rate

The baseload Waste Gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The flow meter is capable of calculating the volumetric flow rate of the Vent Gas by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric flow rate by determining the composition of the Vent Gas and so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The Waste Gas flow rate reflects only the VOC content of the overall Vent Gas composition. The average baseload Vent Gas flow and the average baseload Waste Gas flow rate for the Alky Flare (found below in Table 2-12) were determined using data collected between January 1, 2015 and December 31, 2015.

Table 2-12
Alky Flare Vent Gas and Waste Gas Volumetric Flow Rates

Vent Gas Volumetric Flow Rate (scfd)	Waste Gas Volumetric Flow Rate (scfd)
1,787,068.4	262,594

2.3.4 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-13 shows composition data that is typical for the Alky Flare for the time between January 1, 2015 and December 31, 2015.

Table 2-13
Alky Flare Baseload Constituents

Component	Average Mole %
Nitrogen	76.65
Oxygen	0.05
Water/Steam	0.37
Carbon Dioxide	0.06
Carbon Monoxide	0.0005
Hydrogen	1.02
Hydrogen Sulfide	0.0002
Methane	5.54
Ethane	0.36
Ethylene	0.06
Acetylene	0.001
Propane	2.73
Propylene	2.41
iso-Butane	6.34
n-Butane	1.72
C_4 Olefins	0.12
C_5H_{12}	1.00

2.3.5 Waste Gas Mapping

Waste Gas mapping of the Alky, GDU, PCU, and SRU units was performed through the use of engineering analysis. Data from the ultrasonic flow meter was used to determine the total flow through the flare header. Sweep Gas rates were determined by using rotameter data, and the Waste Gas contributions of individual unit headers were determined using estimates from BPP process engineers and process instrumentation diagrams. The resulting block flow diagram (BFD) of the overall flare layout is provided in Attachment C. It is of note that these flows are only a snapshot in time and can possibly change depending on process unit events.

There was no updated Waste Gas mapping performed in 2015; therefore, there are no updates associated with the First Updated Waste Gas Minimization Plan.

2.3.6 Past Emission Reductions

Provided below in Table 2-14, is a list of preventive measures completed over the past 3 years. These reductions represent a good-faith effort by BPP to reduce flaring prior to the requirements of the Consent Decree. Where possible, an estimate of the reduction is provided. Subsequent updates to this document will list all previously completed or implemented actions conducted prior to the revision date.

Table 2-14
Alky Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2013	Sweep Gas Rotameter Study conducted to identify minimum Sweep Gas rate required to prevent backflow resulting from thermal contraction	NA
2013	Initial Pressure Relief Valve Leak Survey	NA
2012 – Present	Monthly Preventative Maintenance Rounds conducted by Operations to identify leaking PRVs	NA

2.3.7 Flare Specific Planned Reductions

Pursuant to the requirements set forth in the Consent Decree, future preventive measures are summarized in Table 2-15 below along with an anticipated schedule and potential reductions, where capable of being determined.

Table 2-15
Alky Flare Planned Reductions

Estimated Completion Date	Description	Estimated Reductions
December 31, 2016*	Install and commence operation of Flare Gas Recovery System 3, in accordance with the requirements of the BP Whiting Consent Decree.	262 MSCFD**

*Per the first amendment to the Consent Decree that became effective on April 3, 2015, the schedule for connecting Alky Flare to FGRS4 has been changed from before December 31, 2015 to before December 31, 2016.

**Flare Gas Recovery will also absorb some portion of emissions contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

2.3.8 Root Cause Analysis Review

Pursuant to the requirements set forth in the Paragraph 19.b of the CD, BPP shall review all of the Root Cause Analysis reports prepared in order to determine if additional reductions can be achieved through any corrective action(s). There were no RCA reports prepared for the Alky Flare between the date of entry and December 31, 2015 pursuant to Paragraph 54 of the CD.

2.4 4UF Flare

2.4.1 Equipment and Controls

The 4UF Flare is a steam-assisted, elevated flare that was constructed in 1972. The flare header system for the 4UF Flare collects and delivers Vent Gases from the ARU, CFHU, BOU, and 4UF (which contains D-3, D-4, D-5, D-6, D-7, and D-8) units. Gases which are vented from these areas, either from system over-pressurization caused by a malfunction or any other reason, flow into the 4UF Flare Knockout Drum (D-18) and, ultimately, the flare tip.

The 4UF Flare has one knockout drum, which is designed to separate and collect liquid from a Waste Gas stream and ensure that only gas is sent to the flare tip. The remaining liquid is recycled back into the refinery process via knockout drum pumps. Sources entering the flare header system will flow to the knockout drum for liquid separation before being sent to the flare stack for combustion.

The 4UF Flare is identified as S/V 224-06 in the Refinery. The flare stack stands 200 feet above the ground surface and has a flare tip diameter of 36 inches. The flare tip is model 36" NFF-RC-HS, manufactured by NAO, and was last replaced in October 1998. The system contains a total of three 1" pilot lights. An ignition system containing three 1" explosion and weather proof ignition tubes utilizing Flame Front Generator (FFG) ignition provides the energy to cause the desired combustion of the Pilot Gas.

A series of monitoring instruments including Waste Gas, Purge Gas, and steam flow meters and a gas chromatograph (GC) analyze the inputs to the flare header prior to the flare tip. The Waste Gas flow reading, along with information regarding composition from the GC, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. The design of the flare permits adjusting the amount of steam, allowing the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. >98%). Additionally, recording flow rates and compositions allows BPP to evaluate the potential sources of flow more accurately and develop strategies for eliminating or reducing Waste Gas flow.

2.4.2 Waste Gas Volumetric and Mass Flow Rates

The Waste Gas volumetric and mass flow rates can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The volumetric flow rate of the Vent Gas can be derived by an ultrasonic flow meter by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric and mass flow rates by determining the composition of the Vent Gas so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The Waste Gas volumetric and mass 30 day average flow rates for the 4UF Flare (found below in Table 2-16) were determined using data collected between January 1, 2015 and December 31, 2015.

Table 2-16
4UF Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
221.3	1,100.8

2.4.3 Baseload Waste Gas Flow Rate

The baseload Waste Gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The flow meter is capable of calculating the volumetric flow rate of the Vent Gas by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric flow rate by determining the composition of the Vent Gas and so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The Waste Gas flow rate reflects only the VOC content of the overall Vent Gas composition. The average baseload Vent Gas flow rate and the average baseload Waste Gas flow rate for the 4UF Flare (found below in Table 2-17) were determined using data collected between January 1, 2015 and December 31, 2015.

Table 2-17
4UF Flare Vent Gas and Waste Gas Volumetric Flow Rates

Vent Gas Volumetric Flow Rate (scfd)	Waste Gas Volumetric Flow Rate (scfd)
1,392,053.4	335,352

2.4.4 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance, and turnaround activities, as well as emergency flaring situations. The following Table 2-18 shows composition data that is typical for the 4UF Flare for the time between January 1, 2015 and December 31, 2015.

Table 2-18
4UF Flare Baseload Constituents

Component	Average Mole %
Nitrogen	11.25
Oxygen	0.16
Water/Steam	0.68
Carbon Dioxide	0.20
Carbon Monoxide	0.03
Hydrogen	58.94
Hydrogen Sulfide	0.02
Methane	12.56
Ethane	7.87
Ethylene	0.64
Acetylene	0.001
Propane	3.73
Propylene	0.18
iso-Butane	0.48
n-Butane	1.11
C_4 Olefins	0.04
C_5H_{12}	2.66

2.4.5 Waste Gas Mapping

Waste Gas mapping of ARU, CFHU, BOU, and 4UF units was performed through the use of engineering analysis. Data from the ultrasonic flow meter was used to determine the total flow through the flare header. Sweep Gas rates were determined by using rotameter data, and the Waste Gas contributions of individual unit headers were determined using estimates from BPP process engineers and process instrumentation diagrams. The resulting block flow diagram (BFD) of the overall 4UF Flare layout is provided in Attachment D. It is of note that these flows are only a snapshot in time and can possibly change depending on process unit events.

There was no updated Waste Gas mapping performed in 2015; therefore, there are no updates associated with the First Updated Waste Gas Minimization Plan.

2.4.6 Past Emission Reductions

Provided below in Table 2-19, is a list of preventive measures completed over the past 3 years. These reductions represent a good-faith effort by BPP to reduce flaring prior to the requirements of the Consent Decree. Where possible, an estimate of the reduction is provided. Subsequent updates to this document will list all previously completed or implemented actions conducted prior to the revision date.

Table 2-19
4UF Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2013	Sweep Gas Rotameter Study conducted to identify minimum Sweep Gas rate required to prevent backflow resulting from thermal contraction	NA
2013	Initial Pressure Relief Valve Leak Survey	NA
2012 – Present	Monthly Preventative Maintenance Rounds conducted by Operations to identify leaking PRVs	NA

2.4.7 Flare Specific Planned Reductions

Pursuant to the requirements set forth in the Consent Decree, future preventive measures are summarized in Table 2-20 below, along with an anticipated schedule and potential reductions, where capable of being determined.

Table 2-20
4UF Flare Planned Reductions

Estimated Completion Date	Description	Estimated Reductions
December 31, 2016	Install and commence operation of Flare Gas Recovery System 4, in accordance with the requirements of the BP Whiting Consent Decree.	335 MSCFD*

*Flare Gas Recovery will also absorb some portion of emissions contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

2.4.8 Root Cause Analysis Review

Pursuant to the requirements set forth in the Paragraph 19.b of the CD, BPP shall review all of the Root Cause Analysis reports prepared in order to determine if additional reductions can be achieved through any corrective action(s). There have been a total of five (5) RCA reports unique to the 4UF Flare between the date of entry and December 31, 2015 pursuant to Paragraph 54 of the CD. Additionally, the March 12, 2014 event affected both the 4UF and UIU Flares, and the November 21, 2013 event caused flaring at the GOHT, 4UF, UIU, and VRU Flares. RCA action items were completed for the November 21, 2013, January 12, 2014, January 31, 2014, March 12, 2014, and August 28, 2014 events in order to reduce the possibility of flaring events from similar causes. The two RCA events from 2015 are covered in more detail below.

The RCA created for the January 11, 2015 flaring event which resulted in greater than 500 lbs of SO_2 emissions was reviewed for potential waste gas reduction opportunities. The cause of the flaring event was a loss of power at the BOU and 4UF, causing an emergency shutdown of those units. High sulfur streams reached the 4UF Flare due to a faulty control valve. The completed RCA action items, including replacing the faulty control valve, block valves, and bypass valve, as well as updating procedures. As the cause of the event was emergency related, BPP did not find any potential waste gas reductions beyond implementing the procedure to combat this type of flaring event from occurring in the future.

The RCA created for the December 9, 2015 flaring event which resulted in greater than 500 lbs of SO_2 emissions was reviewed for potential waste gas reduction opportunities. The cause of the flaring event was loss of off-gas flow through a control valve from the D-24 Ultrafiner HP Separator, which resulted in high back-pressure that subsequently resulted in pressuring of the D-1 Reactor's inlet relief valves, which lead to the release of hydrogen gas high in hydrogen sulfide to be sent to the 4UF Flare. The incident was reviewed with operations personnel, and the digital control valve was replaced. BPP did not find any potential waste gas reductions beyond the reductions associated with the corrective actions.

2.5 UIU Flare

2.5.1 Equipment and Controls

The UIU Flare is a steam-assisted, elevated flare that was constructed in 1958. The flare header system for the UIU Flare collects and delivers Vent Gases from the CRU, ISOM (which contains Isom D-18), and 3UF units. Gases which are vented from these areas, either from system over-pressurization caused by a malfunction or any other reason, flow into the UIU Flare Knockout Drum (D-24) and, ultimately, the flare tip.

The UIU Flare has one knockout drum, which is designed to separate and collect liquid from a Waste Gas stream and ensure that only gas is sent to the flare tip. The remaining liquid is recycled back into the refinery process via knockout drum pumps. Sources entering the flare header system will flow to the knockout drum for liquid separation before being sent to the flare stack for combustion.

The UIU Flare is identified as S/V 220-04 in the Refinery. The flare stack stands 199.5 feet above the ground surface and has a flare tip diameter of 30 inches. The flare tip is model 30" NFF-SR-HS, manufactured by NAO, and was last replaced in August 2008. The system contains a total of three 3/4" pilot lights. An ignition system containing three 1" explosion and weather proof ignition tubes utilizing Flame Front Generator (FFG) ignition provides the energy to cause the desired combustion of the Pilot Gas.

A series of monitoring instruments including Waste Gas, Purge Gas, and steam flow meters and a gas chromatograph (GC) analyze the inputs to the flare header prior to the flare tip. The Waste Gas flow reading, along with information regarding composition from the GC, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. The design of the flare permits adjusting the amount of steam, allowing the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. >98%). Additionally, recording flow rates and compositions allows BPP to evaluate the potential sources of flow more accurately and develop strategies for eliminating or reducing Waste Gas flow.

2.5.2 Waste Gas Volumetric and Mass Flow Rates

The Waste Gas volumetric and mass flow rates can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The volumetric flow rate of the Vent Gas can be derived by an ultrasonic flow meter by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric and mass flow rates by determining the composition of the Vent Gas so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The average Waste Gas volumetric and mass 30 day average flow rates for the UIU Flare (found below in Table 2-21) were determined using data collected between January 1, 2015 and December 31, 2015.

Table 2-21
UIU Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
642.2	2,076.7

2.5.3 Baseload Waste Gas Flow Rate

The baseload Waste Gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The flow meter is capable of calculating the volumetric flow rate of the Vent Gas by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric flow rate by determining the composition of the Vent Gas and so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The Waste Gas flow rate reflects only the VOC content of the overall Vent Gas composition. The average baseload Vent Gas flow rate and the average baseload Waste Gas flow rate for the UIU Flare (found below in Table 2-22) were determined using data collected between January 1, 2015 and December 31, 2015.

Table 2-22
UIU Flare Vent Gas and Waste Gas Volumetric Flow Rates

Vent Gas Volumetric Flow Rate (scfd)	Waste Gas Volumetric Flow Rate (scfd)
1,379,795.7	925,997

2.5.4 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-23 shows composition data that is typical for the UIU Flare for the time between January 1, 2015 and December 31, 2015.

Table 2-23
UIU Flare Baseload Constituents

Component	Average Mole %
Nitrogen	6.61
Oxygen	0.04
Water/Steam	0.08
Carbon Dioxide	0.85
Carbon Monoxide	0.08
Hydrogen	20.41
Hydrogen Sulfide	0.02
Methane	56.37
Ethane	8.36
Ethylene	2.14
Acetylene	0.00
Propane	2.60
Propylene	0.99
iso-Butane	0.28
n-Butane	0.41
C_4 Olefins	0.03
C_5H_{12}	0.79

2.5.5 Waste Gas Mapping

Waste Gas mapping of the CRU, ISOM, and 3UF units was performed through the use of engineering analysis. Data from the ultrasonic flow meter was used to determine the total flow through the flare header. Sweep Gas rates were determined by using rotameter data, and the Waste Gas contributions of individual unit headers were determined using estimates from BPP process engineers and process instrumentation diagrams. The resulting block flow diagram (BFD) of the overall flare layout is provided in Attachment E. It is of note that these flows are only a snapshot in time and can possibly change depending on process unit events.

2.5.6 Past Emission Reductions

Provided below in Table 2-24, is a list of preventive measures completed over the past 3 years. These reductions represent a good-faith effort by BPP to reduce flaring prior to the requirements of the Consent Decree. Where possible, an estimate of the reduction is provided. Subsequent updates to this document will list all previously completed or implemented actions conducted prior to the revision date.

Table 2-24
UIU Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2013	Sweep Gas Rotameter Study conducted to identify minimum Sweep Gas rate required to prevent backflow resulting from thermal contraction	NA
2013	Initial Pressure Relief Valve Leak Survey	NA
2012 – Present	Monthly Preventative Maintenance Rounds conducted by Operations to identify leaking PRVs	NA

2.5.7 Flare Specific Planned Reductions

Pursuant to the requirements set forth in the Consent Decree, future preventive measures are summarized in Table 2-25 below along with an anticipated schedule and potential reductions, where capable of being determined.

Table 2-25
UIU Flare Planned Reductions

Estimated Completion Date	Description	Estimated Reductions
December 31, 2016	Install and commence operation of Flare Gas Recovery System 4, in accordance with the requirements of the BP Whiting Consent Decree.	926 MSCFD*

*Flare Gas Recovery will also absorb some portion of emissions contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

2.5.8 Root Cause Analysis Review

Pursuant to the requirements set forth in the Paragraph 19.b of the CD, BPP shall review all of the Root Cause Analysis reports prepared in order to determine if additional reductions can be achieved through any corrective action(s). There have been a total of three (3) RCA reports involving the UIU Flare between the date of entry and December 31, 2015 pursuant to Paragraph 54 of the CD. None of the events were unique to just the UIU Flare. RCA action items were completed for the June 20, 2013, November 21, 2013, and the March 12, 2014 events in order to reduce the possibility of flaring events from similar causes. After a review of all RCA events affecting the UIU Flare, no additional reduction opportunities were identified.

2.6 South Flare

2.6.1 Flare Management Plan Provisions of the NSPS Subpart Ja

Per the Consent Decree, the South Flare is subject to the Flare Management Plan provisions of the NSPS Subpart Ja upon startup in 2013. BPP will comply with the most recent version of the NSPS Subpart Ja Flare Management Plan for the South Flare from that date forward, in addition to any non-overlapping provisions in Paragraphs 18-21 and 43 of the CD.[3]

2.6.2 Equipment and Controls

The South Flare is a steam-assisted, elevated flare that was constructed in 2013. The flare header system for the South Flare collects and delivers Vent Gases from the No. 2 Coker (which contains K-401), 12 Pipestill, SRC (which contains TGU-A and TGU-B), VRU 300, and VRU 400 units. Gases which are vented from these areas, either from system over-pressurization caused by a malfunction or any other reason, flow into the South Flare Knockout Drum (D-101) and, ultimately, the flare tip.

The South Flare has one knockout drum, which is designed to separate and collect liquid from a Waste Gas stream and ensure that only gas is sent to the flare tip. The remaining liquid is recycled back into the refinery process via knockout drum pumps. Sources entering the flare header system will flow to the knockout drum for liquid separation before being sent to the flare stack for combustion.

The South Flare is identified as S/V 800-04 in the Refinery. The flare stack stands 350 feet above the ground surface and has a flare tip diameter of 72 inches. The flare tip is model JZ HSA1-72, manufactured by John Zink, and was installed as part of the initial construction of the South Flare in November 2011. The system contains a total of four 1" pilot lights. An ignition system containing four 1" explosion and weather proof ignition tubes utilizing Flame Front Generator (FFG) ignition provides the energy to cause the desired combustion of the Pilot Gas.

A series of monitoring instruments including Waste Gas, Purge Gas, and steam flow meters and a gas chromatograph (GC) analyze the inputs to the flare header prior to the flare tip. The Waste Gas flow reading, along with information regarding composition from the GC, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. The design of the flare permits adjusting the amount of steam, allowing the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. >98%). Additionally, recording flow rates and compositions allows BPP to evaluate the potential sources of flow more accurately and develop strategies for eliminating or reducing Waste Gas flow.

[3] Note, the original South FMP was submitted to U.S. EPA on March 21, 2013, pursuant to 40 CFR 60.103a(b). An updated FMP was submitted January 29, 2016.

2.6.3 Waste Gas Volumetric and Mass Flow Rates

The Waste Gas volumetric and mass flow rates can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The volumetric flow rate of the Vent Gas can be derived by an ultrasonic flow meter by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric and mass flow rates by determining the composition of the Vent Gas so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The average Waste Gas volumetric and mass 30 day average flow rates for the South Flare (found below in Table 2-26) were determined using data collected between January 1, 2015 and December 31, 2015.

Table 2-26
South Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
0.0	0.0

2.6.4 Baseload Waste Gas Flow Rate

The Consent Decree specifically excludes South Flare from the baseload calculation requirement.

2.6.5 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-27 shows composition data that is typical for the South Flare for the time between January 1, 2014 and December 31, 2014.

Table 2-27
South Flare Baseload Constituents

Component	Average Mole %
Nitrogen	6.60
Oxygen	0.02
Water/Steam	0.58
Carbon Dioxide	0.81
Carbon Monoxide	0.01
Hydrogen	6.62
Hydrogen Sulfide	0.41
Methane	69.14
Ethane	4.86

Ethylene	0.85
Acetylene	0.01
Propane	1.43
Propylene	0.61
iso-Butane	0.52
n-Butane	1.63
C_4 Olefins	0.23
C_5H_{12}	5.03

2.6.6 Waste Gas Mapping

Waste Gas mapping of No. 2 Coker, 12 Pipestill, SRC, VRU 300, and VRU 400 units was performed through the use of instrumentation data. Data from the ultrasonic flow meter was used to determine the total flow through the flare header. Sweep Gas rates were determined by using rotameter data, and the Waste Gas contributions of individual unit headers were determined using data from flow meters monitoring flow from the individual units to the main flare header. The resulting block flow diagram (BFD) of the overall flare layout is provided in Attachment F. It is of note that these flows are only a snapshot in time and can possibly change depending on process unit events.

There was no updated Waste Gas mapping performed in 2015; therefore, there are no updates associated with the First Updated Waste Gas Minimization Plan.

2.6.7 Past Emission Reductions

Provided below in Table 2-28, is a list of preventive measures completed over the past 3 years. Because the South Flare was constructed recently, BP (and its contractors) had the opportunity to identify design strategies to minimize flow to the flare header from each connection. The identified design strategies were implemented in the construction of the flare header and as such, the flare header system has been constructed to achieve minimization of flow to the header.

Table 2-28
South Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2013	Install and commence operation of Flare Gas Recovery System 1, in accordance with the requirements of the BP Whiting Consent Decree.	1,544 MSCFD*

*Flare Gas Recovery will also absorb some portion of emissions contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

2.6.8 Flare Specific Planned Reductions

At present, the flows to the South Flare are expected to be completely minimized, as the FGR system was designed to handle the anticipated normal flows from the South Flare header. In the event that routine breakthroughs are observed after the South Flare becomes operational, BPP will conduct further minimization investigations.

The FGR system installed on the South Flare consists of two (2) liquid ring compressors (LRCs). Each compressor has a capacity of 1,053 scfm, providing a total recovery capacity of 2,106 scfm. Typical recovery rates during normal operation are approximately 790 scfm.

2.6.9 Root Cause Analysis Review

Pursuant to the requirements set forth in the Paragraph 70.b of the CD, for each Covered Flare and the LPG Flare, upon the date that each such flare becomes an "affected facility" under NSPS Ja, the requirements in Sections I. and J. of Appendix D of the CD no longer apply. The South Flare became an affected facility under NSPS Ja upon startup in 2013. Therefore, there have been no Root Cause Analysis reports prepared pursuant to Paragraph 54 of the CD. Therefore, there were no potential reductions associated with additional changes found during a RCA, per Paragraph 19.b of the CD.

2.7 GOHT Flare

2.7.1 Flare Management Plan Provisions of the NSPS Subpart Ja

Per the Consent Decree, the GOHT Flare is subject to the Flare Management Plan provisions of the NSPS Subpart Ja upon startup in 2013. BPP will comply with the most recent version of the NSPS Subpart Ja Flare Management Plan for the GOHT Flare from that date forward, in addition to any non-overlapping provisions in Paragraphs 18-21 and 43 of the CD.[4]

2.7.2 Equipment and Controls

The GOHT Flare is a steam-assisted, elevated flare that was constructed in 2012. The flare header system for the GOHT Flare collects and delivers Vent Gases from the GOHT unit. Gases which are vented from these areas, either from system over-pressurization caused by a malfunction or any other reason, flow into the GOHT Flare Knockout Drum (D-946) and, ultimately, the flare tip.

The GOHT Flare has one knockout drum, which is designed to separate and collect liquid from a Waste Gas stream and ensure that only gas is sent to the flare tip. The remaining liquid is recycled back into the refinery process via knockout drum pumps. Sources entering the flare header system will flow to the knockout drum for liquid separation before being sent to the flare stack for combustion.

[4] Note, the original GOHT FMP was submitted to U.S. EPA on July 2, 2014, pursuant to 40 CFR 60.103a(b). An updated FMP was submitted January 29, 2016.

The GOHT Flare is identified as S/V 802-03 in the Refinery. The flare stack stands 316 feet above the ground surface and has a flare tip diameter of 60 inches. The flare tip is model 60" JZ HSA1-SH-60, manufactured by John Zink, and was installed as part of the initial construction of the GOHT Flare in February 2012. The system contains a total of four 1" pilot lights. An ignition system containing four 1" explosion and weather proof ignition tubes utilizing Flame Front Generator (FFG) ignition provides the energy to cause the desired combustion of the Pilot Gas.

A series of monitoring instruments including Waste Gas, Purge Gas, and steam flow meters and a gas chromatograph (GC) analyze the inputs to the flare header prior to the flare tip. The Waste Gas flow reading, along with information regarding composition from the GC, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. The design of the flare permits adjusting the amount of steam, allowing the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. >98%). Additionally, recording flow rates and compositions allows BPP to evaluate the potential sources of flow more accurately and develop strategies for eliminating or reducing Waste Gas flow.

2.7.3 Waste Gas Volumetric and Mass Flow Rates

The Waste Gas volumetric and mass flow rates can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The volumetric flow rate of the Vent Gas can be derived by an ultrasonic flow meter by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric and mass flow rates by determining the composition of the Vent Gas so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The average Waste Gas volumetric and mass 30 day average flow rates for the GOHT Flare (found below in Table 2-29) were determined using data collected between January 1, 2015 and December 31, 2015.

Table 2-29
GOHT Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
0.0	0.0

2.7.4 Baseload Waste Gas Flow Rate

The Consent Decree specifically excludes GOHT Flare from the baseload calculation requirement.

2.7.5 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-30 shows composition data that is typical for the GOHT Flare for the time between January 1, 2014 and December 31, 2014.

Table 2-30
GOHT Flare Baseload Constituents

Component	Average Mole %
Nitrogen	20.47
Oxygen	0.03
Water/Steam	0.21
Carbon Dioxide	0.47
Carbon Monoxide	0.01
Hydrogen	33.45
Hydrogen Sulfide	0.02
Methane	38.12
Ethane	3.34
Ethylene	0.64
Acetylene	0.00
Propane	0.64
Propylene	0.32
iso-Butane	0.10
n-Butane	0.19
C_4 Olefins	0.03
C_5H_{12}	0.38

2.7.6 Waste Gas Mapping

Waste Gas mapping of the GOHT unit was performed through the use of instrumentation data. Data from the ultrasonic flow meter was used to determine the total flow through the flare header. Sweep Gas rates were determined by using rotameter data, and the Waste Gas contributions of individual unit headers were determined using data from flow meters monitoring flow from the individual units to the main flare header. The resulting block flow diagram (BFD) of the overall flare layout is provided in Attachment G. It is of note that these flows are only a snapshot in time and can possibly change depending on process unit events.

There was no updated Waste Gas mapping performed in 2015; therefore, there are no updates associated with the First Updated Waste Gas Minimization Plan.

2.7.7 Past Emission Reductions

Provided below in Table 2-31, is a list of preventive measures completed over the past 3 years. Because the GOHT Flare was constructed recently, BP (and its contractors) had the opportunity to identify design strategies to minimize flow to the flare header from each connection. The identified design strategies were implemented in the construction of the flare header and as such, the flare header system has been constructed to achieve minimization of flow to the header.

Table 2-31
GOHT Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2012	Install and commence operation of Flare Gas Recovery System 2, in accordance with the requirements of the BP Whiting Consent Decree.	472 MSCFD*

*Flare Gas Recovery will also absorb some portion of emissions contributions from Startup, Shutdown, and Malfunction; BPP expects the actual reduction to exceed the baseload volume.

2.7.8 Flare Specific Planned Reductions

At present, the flows to the GOHT Flare are expected to be completely minimized, as the FGR system was designed to handle the anticipated normal flows from the GOHT Flare header. In the event that routine breakthroughs are observed after the GOHT Flare becomes operational, BPP will conduct further minimization investigations.

The FGR system installed on the GOHT Flare consists of two (2) liquid ring compressors (LRCs). Each compressor has a capacity of 1,053 scfm, providing a total recovery capacity of 2,106 scfm. Typical recovery rates during normal operation are approximately 328 scfm.

2.7.9 Root Cause Analysis Review

Pursuant to the requirements set forth in the Paragraph 70.b of the CD, for each Covered Flare and the LPG Flare, upon the date that each such flare becomes an "affected facility" under NSPS Ja, the requirements in Sections I. and J. of Appendix D of the CD no longer apply. The South Flare became an affected facility under NSPS Ja upon startup in 2013. Therefore, there have been no Root Cause Analysis reports prepared pursuant to Paragraph 54 of the CD. Therefore, there were no potential reductions associated with additional changes found during a RCA, per Paragraph 19.b of the CD.

2.8 DDU Flare

2.8.1 Flare Management Plan Provisions of the NSPS Subpart Ja

As of November 11, 2015, the DDU Flare is subject to the Flare Management Plan provisions of the NSPS Subpart Ja. BPP will comply with the most recent version of the NSPS Subpart Ja Flare Management Plan for the DDU Flare from that date forward, in addition to any non-overlapping provisions in Paragraphs 18-21 and 43 of the CD.[5]

2.8.2 Equipment and Controls

The DDU Flare is a steam-assisted, elevated flare that was constructed in July 1993. The flare header system for the DDU Flare collects and delivers Vent Gases from the DDU, DHT, 11A Pipestill, and 11C Pipestill units. Gases which are vented from these areas, either from system over-pressurization caused by a malfunction or any other reason, flow into the DDU Flare Knockout Drum (F-315) and, ultimately, the flare tip.

The DDU Flare has one knockout drum, which is designed to separate and collect liquid from a Waste Gas stream and ensure that only gas is sent to the flare tip. The remaining liquid is recycled back into the refinery process via knockout drum pumps. Sources entering the flare header system will flow to the knockout drum for liquid separation before being sent to the flare stack for combustion.

The DDU Flare is identified as S/V 698-02 in the Refinery. The flare stack stands 195 feet above the ground surface and has a flare tip diameter of 60 inches. The flare tip is model BTZ-US-60/24C, manufactured by Callidus, and was last replaced in June 2005. The system contains a total of six 3/4" pilot lights. An ignition system containing three 1" explosion and weather proof ignition tubes utilizing Flame Front Generator (FFG) ignition and three 2" explosion and weather proof ignition tubes utilizing Self Inspirating FFG ignition provide the energy to cause the desired combustion of the Pilot Gas.

A series of monitoring instruments including Waste Gas, Purge Gas, and steam flow meters and a gas chromatograph (GC) analyze the inputs to the flare header prior to the flare tip. The Waste Gas flow reading, along with information regarding composition

[5] Note, the original DDU FMP was submitted to U.S. EPA on November 11, 2015, pursuant to 40 CFR 60.103a(b).

from the GC, is used to signal the steam controller to adjust the amount of steam sent to the flare tip. The design of the flare permits adjusting the amount of steam, allowing the flare to operate with optimal conditions to ensure proper combustion efficiency (i.e. >98%). Additionally, recording flow rates and compositions allows BPP to evaluate the potential sources of flow more accurately and develop strategies for eliminating or reducing Waste Gas flow.

2.8.3 Waste Gas Volumetric and Mass Flow Rates

The Waste Gas volumetric and mass flow rates can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The volumetric flow rate of the Vent Gas can be derived by an ultrasonic flow meter by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric and mass flow rates by determining the composition of the Vent Gas so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The average Waste Gas volumetric and mass 30 day average flow rates for the DDU Flare (found below in Table 2-32) were determined using data collected between January 1, 2015 and December 31, 2015.

Table 2-32
DDU Flare Waste Gas Volumetric and Mass Flow Rates

Waste Gas Volumetric Flow Rate (scfm)	Waste Gas Mass Flow Rate (pounds per hour)
771.1	2,249.8

2.8.4 Baseload Waste Gas Flow Rate

The baseload Waste Gas flow rate can be determined for the flare systems by utilizing an ultrasonic flow meter and gas chromatograph (GC). The flow meter is capable of calculating the volumetric flow rate of the Vent Gas by determining the Vent Gas velocity and using the known inner diameter of the pipe in which the flow meter is installed. The GC allows for the calculation of the Waste Gas volumetric flow rate by determining the composition of the Vent Gas and so that inert species within the Vent Gas (Hydrogen, Oxygen, Nitrogen, Carbon Monoxide, Carbon Dioxide, and Water/Steam) can be excluded from the calculations. The Waste Gas flow rate reflects only the VOC content of the overall Vent Gas composition. The average baseload Vent Gas flow rate and the average baseload Waste Gas flow rate for the DDU Flare (found below in Table 2-33) were determined using data collected between January 1, 2015 and December 31, 2015.

Table 2-33
DDU Flare Vent Gas and Waste Gas Volumetric Flow Rates

Vent Gas Volumetric Flow Rate (scfd)	Waste Gas Volumetric Flow Rate (scfd)
2,133,928	1,110,271

2.8.5 Identification of Constituent Gases

Under normal refinery operating conditions, gases vented to the flare from the various refinery units have a typical composition. This gas composition varies between flares due to the difference in the functions of the units each flare services. Gas composition is determined through the use of a gas chromatograph (GC). This average composition can vary during flaring incidents related to startup, shutdown, maintenance and turnaround activities, as well as emergency flaring situations. The following Table 2-34 shows composition data that is typical for the DDU Flare for the time between January 1, 2015 and December 31, 2015.

Table 2-34
DDU Flare Baseload Constituents

Component	Average Mole %
Nitrogen	30.23
Oxygen	0.02
Water/Steam	0.66
Carbon Dioxide	0.61
Carbon Monoxide	0.06
Hydrogen	14.10
Hydrogen Sulfide	0.001
Methane	41.45
Ethane	6.55
Ethylene	1.60
Acetylene	0.00
Propane	2.06
Propylene	0.76
iso-Butane	0.17
n-Butane	0.28
C_4 Olefins	0.04
C_5H_{12}	0.39

2.8.6 Waste Gas Mapping

Waste Gas mapping of the DDU, DHT, 11A Pipestill, and 11C Pipestill units was performed through the use of engineering analysis. Data from the ultrasonic flow meter was used to determine the total flow through the flare header. Sweep Gas rates were determined by using rotameter data, and the Waste Gas contributions of individual unit headers were determined using estimates from BPP process engineers and process instrumentation diagrams. The resulting block flow diagram (BFD) of the flare is provided in Attachment H. It is of note that these flows are only a snapshot in time and can possibly change depending on process unit events.

2.8.7 Past Emission Reductions

Provided below in Table 2-35, is a list of preventive measures completed over the past 3 years. These reductions represent a good-faith effort by BPP to reduce flaring prior to the requirements of the Consent Decree. Where possible, an estimate of the reduction is provided. Subsequent updates to this document will list all previously completed or implemented actions conducted prior to the revision date.

Table 2-35
DDU Flare Reductions Previously Realized

Year Installed or Implemented	Description	Estimated Reductions
2013	Sweep Gas Rotameter Study conducted to identify minimum Sweep Gas rate required to prevent backflow resulting from thermal contraction	NA
2013	Initial Pressure Relief Valve Leak Survey	NA
2012 – Present	Monthly Preventative Maintenance Rounds conducted by Operations to identify leaking PRVs	NA

2.8.8 Flare Specific Planned Reductions

Pursuant to the requirements set forth in the Consent Decree, BPP will continue to investigate ways to reduce flaring potential from sources.

2.8.9 Root Cause Analysis Review

Pursuant to the requirements set forth in the Paragraph 19.b of the CD, BPP shall review all of the Root Cause Analysis reports prepared in order to determine if additional reductions can be achieved through any corrective action(s). There were no CD RCA reports prepared for the DDU Flare between the date of entry and December 31, 2015 pursuant to Paragraph 54 of the CD. Therefore, there were no potential reductions associated with additional changes found during a RCA, per Paragraph 19.b of the CD.

SECTION 3
REFINERY-WIDE FLARING PREVENTION MEASURES

3.1 Administrative Policies and Procedures

It is the policy of BPP to assure that process vents are designed to send Vent Gases to a refinery flare to be safely burned and to reduce the potential for explosion, fire, or other safety hazard. Flares are to be used only to the extent that they are required to protect workers and the nearby community, and to ensure reliable operation of process equipment, such as during startup, shutdown, malfunction, and/or major maintenance. All other flaring is not permitted per this policy.

As part of the WGMP activities, with the exception of the scenarios described in Paragraph 56 in Appendix D of the Consent Decree, root cause analyses must be conducted for each flaring incident with a Waste Gas flow rate of over 500,000 scf (effective upon triggering NSPS Subpart Ja or June 30, 2016, per Appendix D of the Consent Decree) excluding the pro-rated Baseload Waste Gas Flow Rate, or sulfur dioxide (SO_2) emission of greater than 500 pounds (effective November 6, 2012) over a 24-hour period. The root cause analyses should be conducted in accordance with the requirements of Paragraph 54 in Appendix D of the Consent Decree.

3.2 Equipment and Hardware

BPP has installed automated steam control equipment to monitor flow to the flare systems and adjust steam rates to optimize combustion. The steam control systems use flare gas data collected from various instruments to determine the steam demand and thus control the amount of steam sent to the flare via automated steam valves.

The FGR system installed on the South Flare consists of two (2) liquid ring compressors (LRCs). Each compressor has a capacity of 1,053 scfm, providing a total recovery capacity of 2,106 scfm. Typical recovery rates during normal operation are approximately 790 scfm.

The FGR system installed on the GOHT Flare consists of two (2) LRCs. Each compressor has a capacity of 1,053 scfm, providing a total recovery capacity of 2,106 scfm. Typical recovery rates during normal operation are approximately 328 scfm.

The Flare Gas Recovery System (FGRS) 3 was installed and operational as of December 31, 2015. Both the VRU and FCU Flares are connected to FGRS 3, and the Alky Flare will be connected to FGRS 3 by December 31, 2016. FGRS 3 consists of four (4) LRCs, each with 62.5 Mscfh (1042 scfm) capacity. Typical recovery rates from the current configuration (VRU and FCU Flare) are approximately 14.22 Mscfh (237 scfm). Note that FGRS 4 will come online by December 31, 2016, and will be connected to the 4UF and UIU Flares.

Hydrocarbon Flaring Incidents Root Cause Analyses were reviewed from the Date of Entry through December 31, 2015. No flaring events were identified as a result of Waste Gas quantity or quality. Future revisions will identify and report flaring caused by Waste Gas quantity or quality issues, as necessary, covering the previous three (3) years.

3.2.1 Vent Gas Flow Rate, Temperature, and Molecular Weight

An ultrasonic flow meter measures the flow rate, temperature, and molecular weight of Vent Gas sent to the flare. This flow meter, however, cannot distinguish between two compounds with the same molecular weight, such as propane and carbon dioxide (44 grams/mole). Therefore, the Vent Gas molecular weight cannot be independently used in steam control logic. A gas chromatograph is used in conjunction to determine the Vent Gas composition and provide a more accurate indication of hydrocarbon levels in the Vent Gas.

3.2.2 Vent Gas Composition

The Vent Gas will be monitored by a gas chromatograph to determine Vent Gas composition and heat content (Btu/scf). This monitoring system provides a data point approximately once every ten minutes which is used to verify molecular weight readings from the flow meter. A sulfur analyzer in the GC is also capable of determining the amount of hydrogen sulfide for Vent Gas sulfur content purposes.

3.2.3 Volumetric Flow – Vent Gas

Ultrasonic flow meters installed in the flare system provide the flow velocity of the Vent Gas on a continuous basis. The volumetric flow of the Vent Gas can be derived from the Vent Gas velocity by incorporating the cross sectional area of the pipe in which the flow meter is installed. The flow meter directly provides the volumetric flow rate so that no external calculations are required.

3.2.4 Mass Flow – Steam and Vent Gas

Ultrasonic flow meters are also used to determine the mass flow rates of the steam and Vent Gas on a continuous basis. Using the molecular weight and molar flow rate of the Vent Gas, the mass flow rate can be calculated. The flow meter directly outputs the mass flow rate with no need for external calculations.

3.3 Major Maintenance/Turnaround

During maintenance on equipment and processes it is often necessary to purge equipment of all vapors for safety and environmental reasons. These purges are sent to the relief gas system potentially leading to flaring; however, on flares equipped with Flare Gas Recovery, BPP sequences these purges in an attempt to minimize the potential for overloading the FGR. BPP attempts to limit maintenance requiring equipment purges to flare; however, this can be unavoidable in order to provide for internal inspections and equipment cleanout or replacement. For the purpose of this section, maintenance activities are scheduled process unit turnarounds as well as near-term shutdowns planned for other maintenance activities. BPP evaluated these past activities over the last four (4) years to determine the feasibility of reducing or eliminating flaring during these activities in the future. The evaluation consisted of reviewing the Refinery's Flaring Incident Database as well as SSM Plans and Event Forms required by Refinery MACT CC (e.g. 40 CFR 63 Subpart CC). Table 3-1 lists the results of this evaluation.

Table 3-1
Flaring Caused by Maintenance*

Date	Unit	Affected Flare	Description
1-31-2014	BOU	4UF	In preparation for maintenance, equipment was purged with steam leading to a high sulfur gas stream being sent to the flare. Operations switched to a nitrogen purge and the flaring event ended.

*Review of flaring caused by maintenance was completed for the First Updated WGMP, but there was no maintenance flaring in 2015.

It is the goal of all planned maintenance activities to limit the amount of hydrocarbon gases sent to the flare during process equipment purging. When possible, pressurized gases in process equipment are sent to another process unit or to the refinery fuel gas system, as opposed to the relief gas system. Liquids can also be pumped to storage or other process units prior to purging to the relief gas system. However, although most material can be removed, residual vapors and liquids may remain. The relief gas system is a low-pressure system utilized to safely vent these residual materials.

Purging of process equipment is accomplished using an inert gas (e.g., nitrogen) or steam depending on the properties of the material to be purged. Steam is often more effective for heavier hydrocarbons by increasing the volatility via the increase in temperature. However, it also may lead to concerns regarding equipment corrosion from the condensation of water in the equipment. The determination of what purge method to use can reduce flaring by ensuring the most effective means are employed and the load burden on the flare system is reduced.

In BPP's effort to continue improving process reliability, mechanical integrity and reliability assessments are conducted prior to major maintenance and turnarounds to ensure that the best technology is used. The constant improvement in materials and technology leads to fewer required turnarounds and a reduction in associated flaring events. BPP continues to review mechanical integrity prior to turnaround activities and expects to continually increase the time between these events.

3.4 Recurrent Equipment Failures

Recurrent failures of air pollution control equipment, process equipment, or a process to operate in a normal or usual manner which cause flaring events are any event occurring more than two times over a five year period as a result of the same cause. These events would be identified through root cause analyses and tracked by the refinery beginning on the creation date of this document.

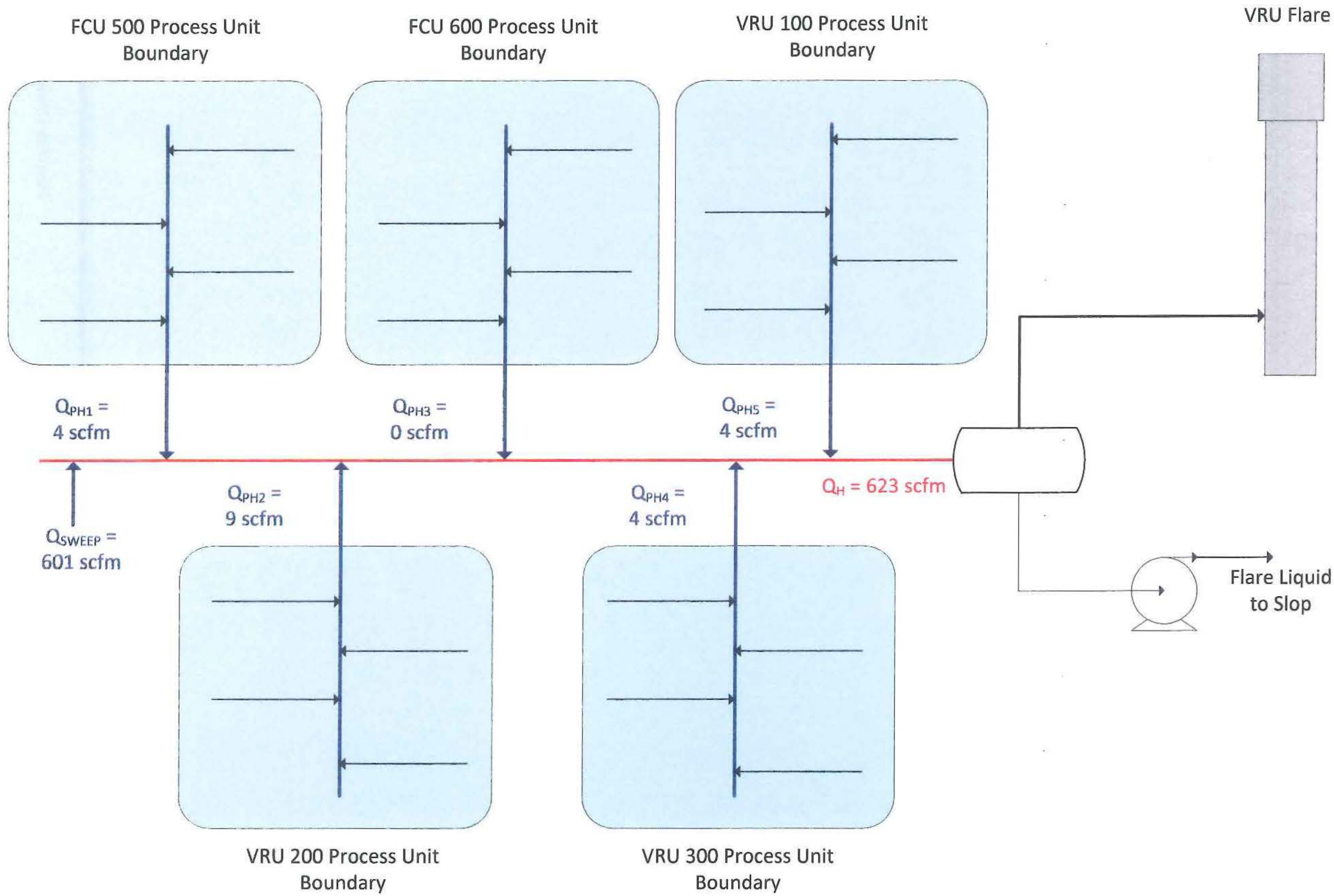
The refinery has in place a thorough preventive maintenance program, consistent with the Preventative Maintenance Plan requirements of 326 IAC 1-6-3, which includes the inspection and testing of critical process components. This program is consistent with recognized industry standards. The objective of the program is to maintain the reliability of equipment so that failures and other types of process upsets are eliminated. While refinery flare systems were designed to safely handle such emergency events, when upsets do occur investigations are conducted to determine the root cause(s) and identify preventive/corrective actions.

Hydrocarbon Flaring Incidents root cause analyses were reviewed from the Date of Entry through December 31, 2015 and no recurrent equipment failures were identified. Future revisions will identify and report recurrent equipment failures, as necessary, covering the period from Date of Entry until the date of submission until November 6, 2017, at which point the previous five (5) years will be reviewed.

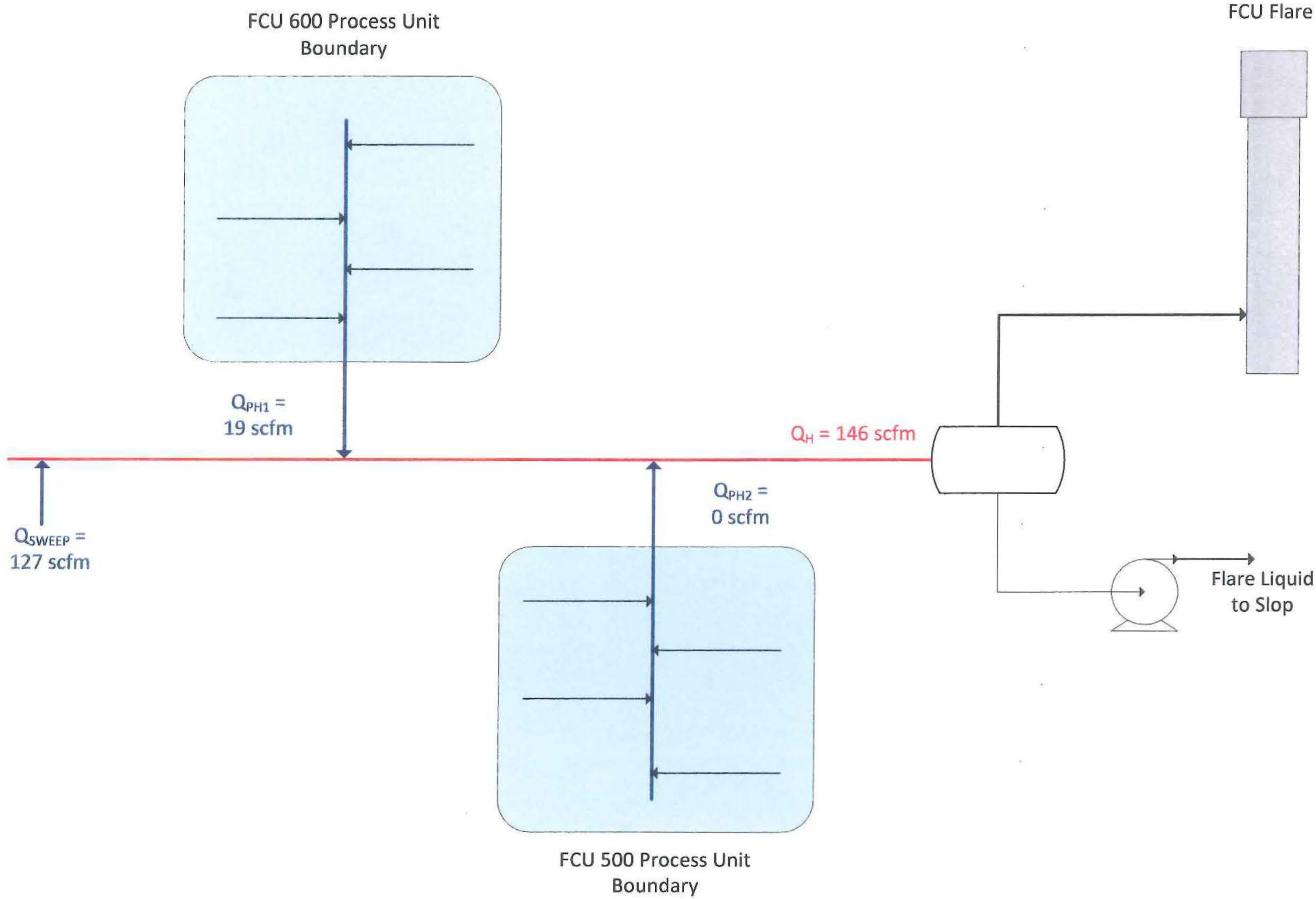
3.5 Other Potential Flaring Events

For events with a potential to cause flaring, planning is conducted to determine ways to avoid flaring. This includes major maintenance and turnarounds and new installations/upgrades. Project committees are tasked with developing strategies to limit the amount of flaring to only the instances that are absolutely necessary. Additionally, when there is a flaring event, processes are in place to evaluate the extent of the event and determine the cause. Using root cause analyses, the Whiting Refinery will evaluate the flaring event and use the data collected to plan for better procedures and processes or more appropriate equipment. Lastly, potential preventive measures are selected based on the planning and evaluations and are incorporated into subsequent revisions of this document and implemented at BPP.

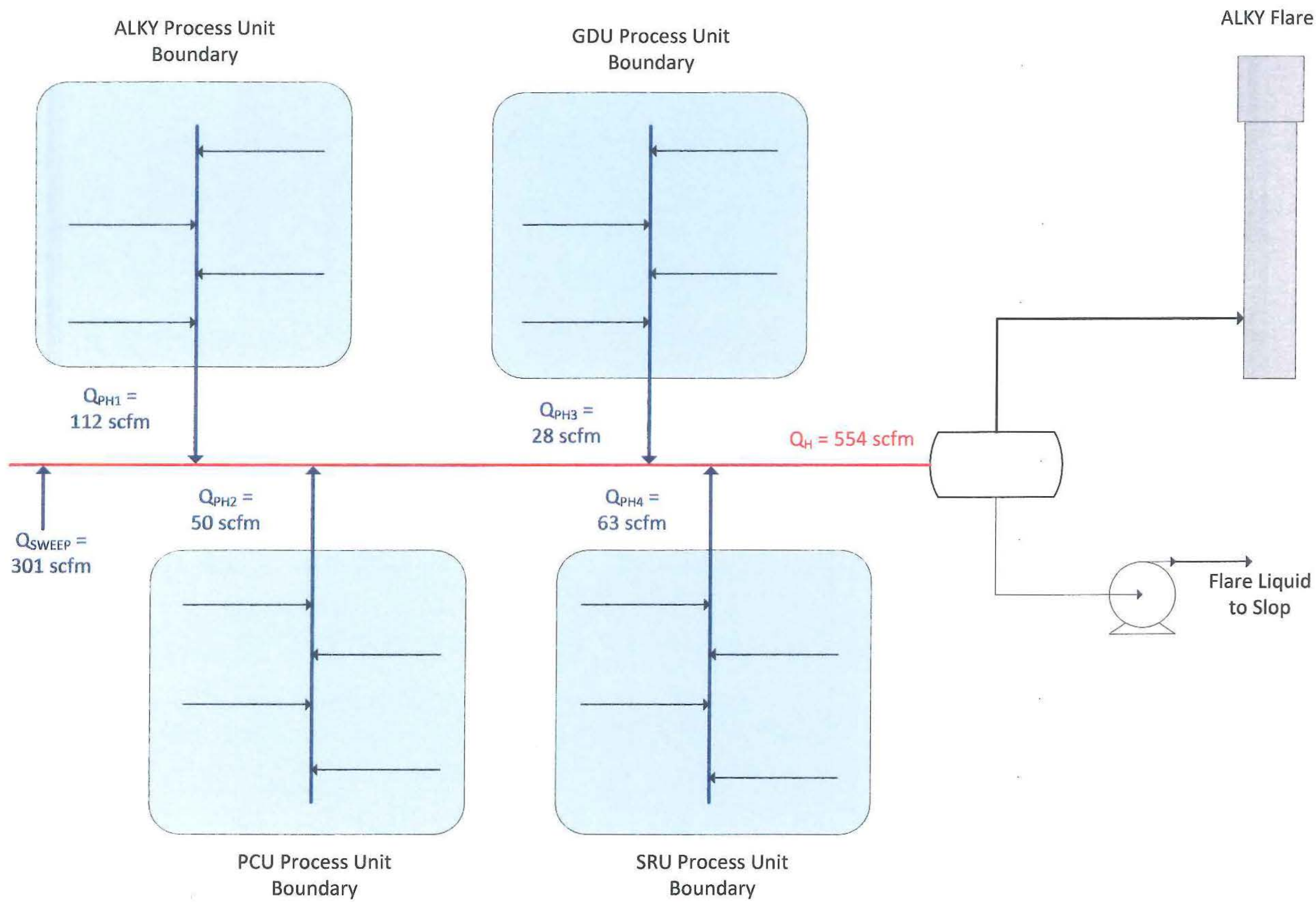
ATTACHMENT A
VRU FLARE WASTE GAS FLOWS


FCU 500 Process Unit Boundary
FCU 600 Process Unit Boundary
VRU 100 Process Unit Boundary
VRU Flare
Q_{PH1} = 4 scfm
Q_{PH3} = 0 scfm
Q_{PH5} = 4 scfm
Q_{PH2} = 9 scfm
Q_{PH4} = 4 scfm
Q_H = 623 scfm
Q_{SWEEP} = 601 scfm
Flare Liquid to Slop
VRU 200 Process Unit Boundary
VRU 300 Process Unit Boundary

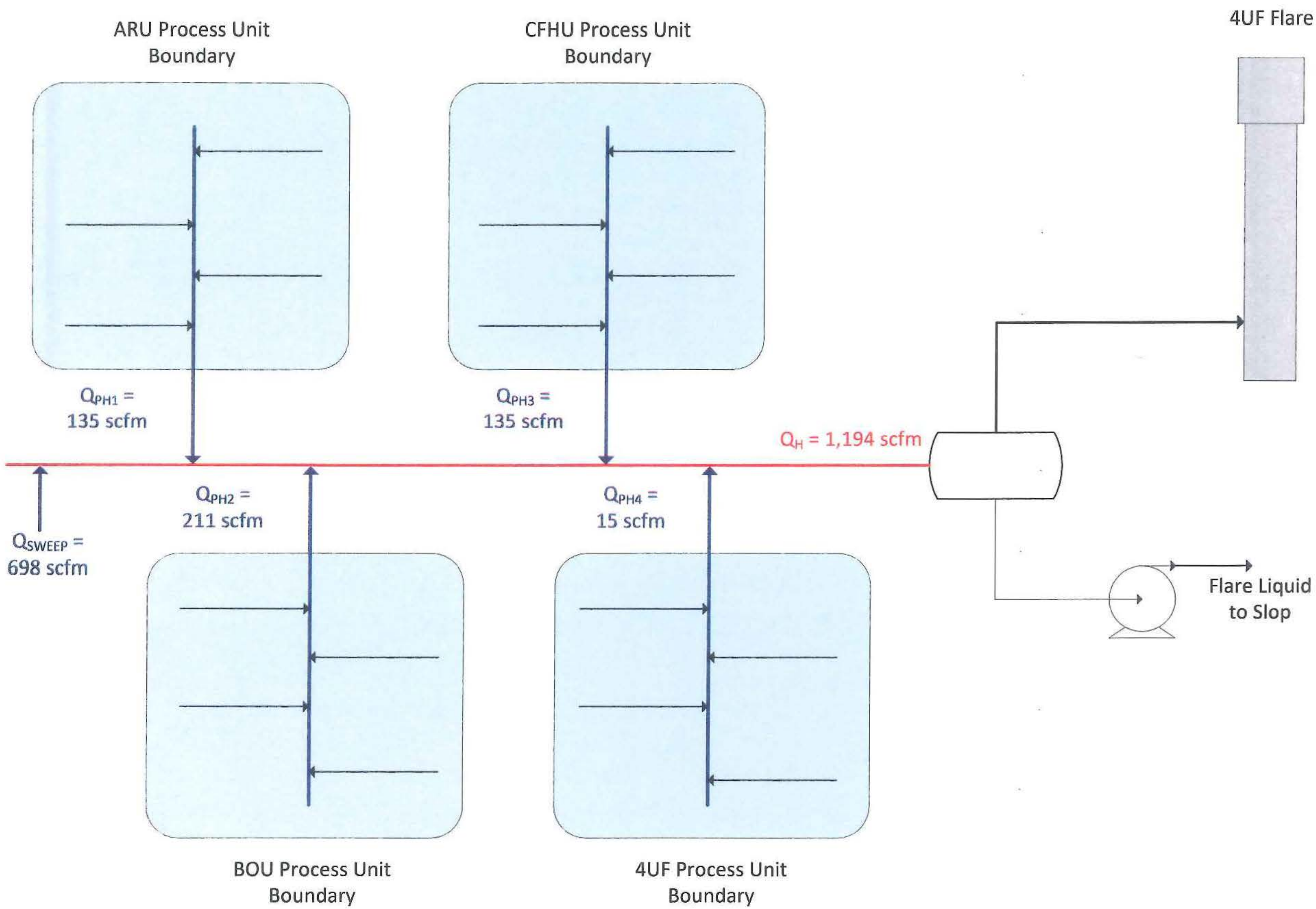
ATTACHMENT B
FCU FLARE WASTE GAS FLOWS


FCU 600 Process Unit Boundary
FCU Flare
Q_{PH1} = 19 scfm
Q_H = 146 scfm
Q_{SWEEP} = 127 scfm
Q_{PH2} = 0 scfm
Flare Liquid to Slop
FCU 500 Process Unit Boundary

ATTACHMENT C
ALKY FLARE WASTE GAS FLOWS

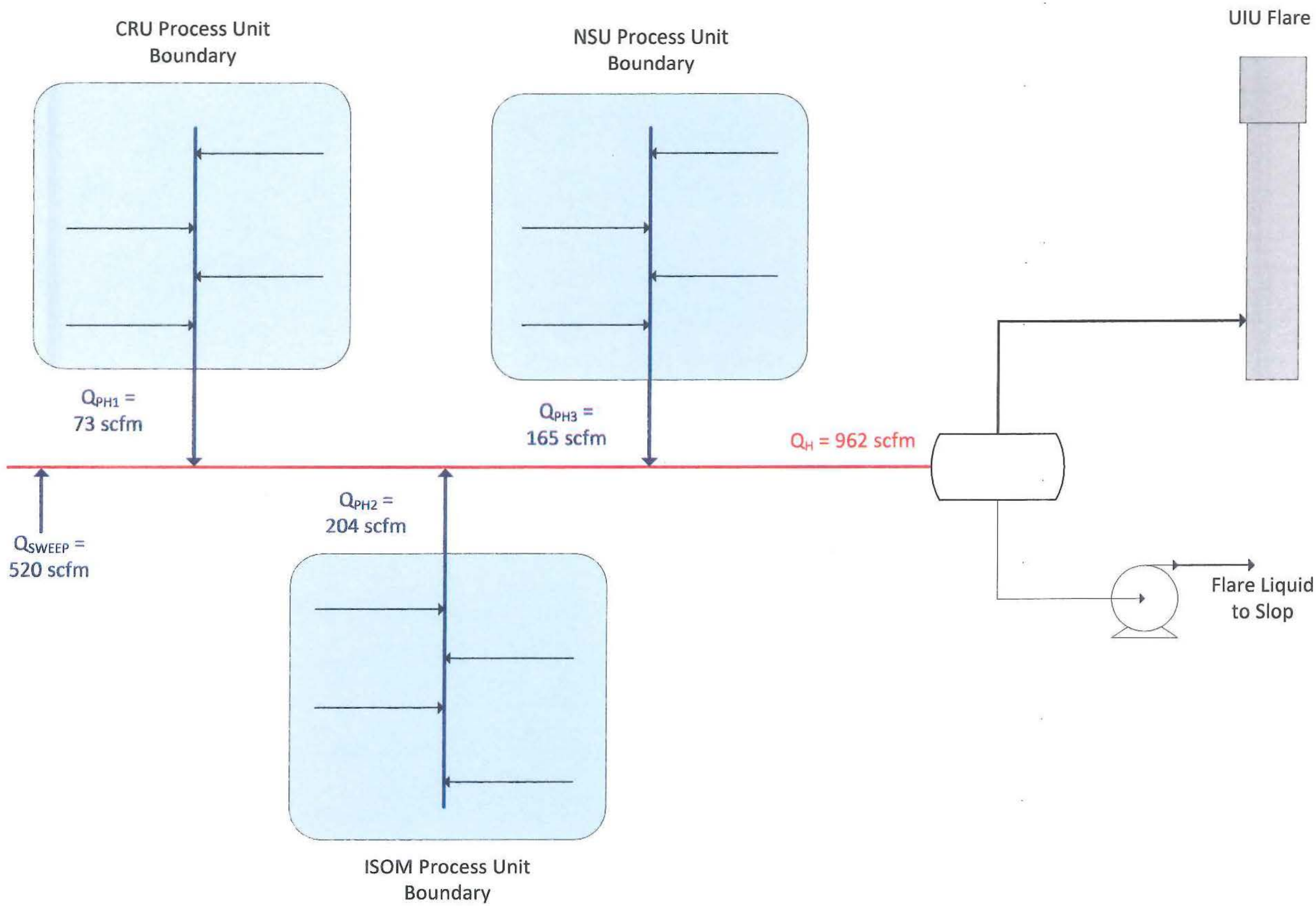

ALKY Process Unit Boundary
GDU Process Unit Boundary
ALKY Flare
Q_{PH1} = 112 scfm
Q_{PH3} = 28 scfm
Q_H = 554 scfm
Q_{PH2} = 50 scfm
Q_{PH4} = 63 scfm
Q_{SWEEP} = 301 scfm
Flare Liquid to Slop
PCU Process Unit Boundary
SRU Process Unit Boundary

ATTACHMENT D
4UF FLARE WASTE GAS FLOWS

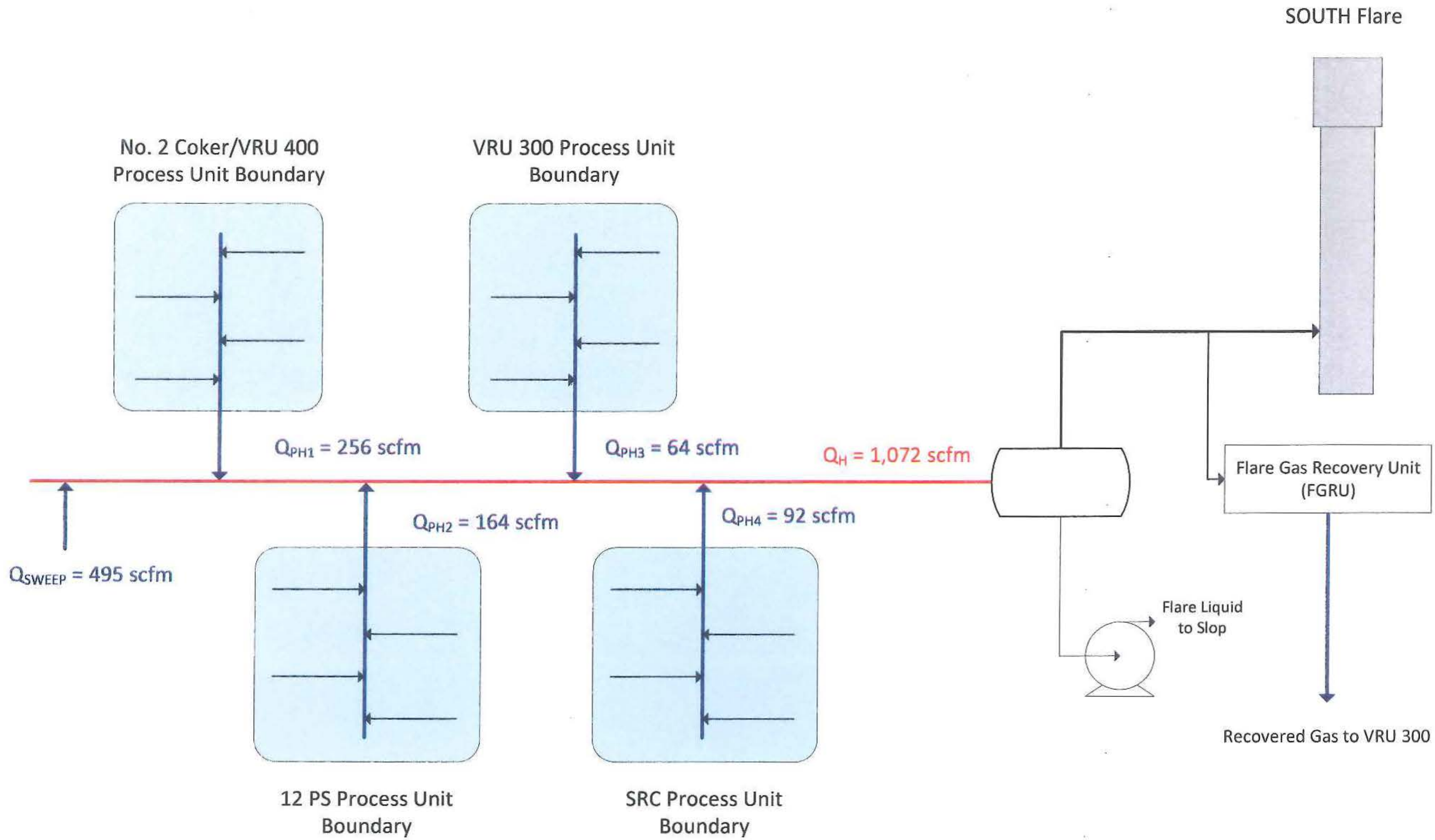


ARU Process Unit Boundary
CFHU Process Unit Boundary
4UF Flare
Q_{PH1} = 135 scfm
Q_{PH3} = 135 scfm
Q_H = 1,194 scfm
Q_{PH2} = 211 scfm
Q_{PH4} = 15 scfm
Q_{SWEEP} = 698 scfm
Flare Liquid to Slop
BOU Process Unit Boundary
4UF Process Unit Boundary

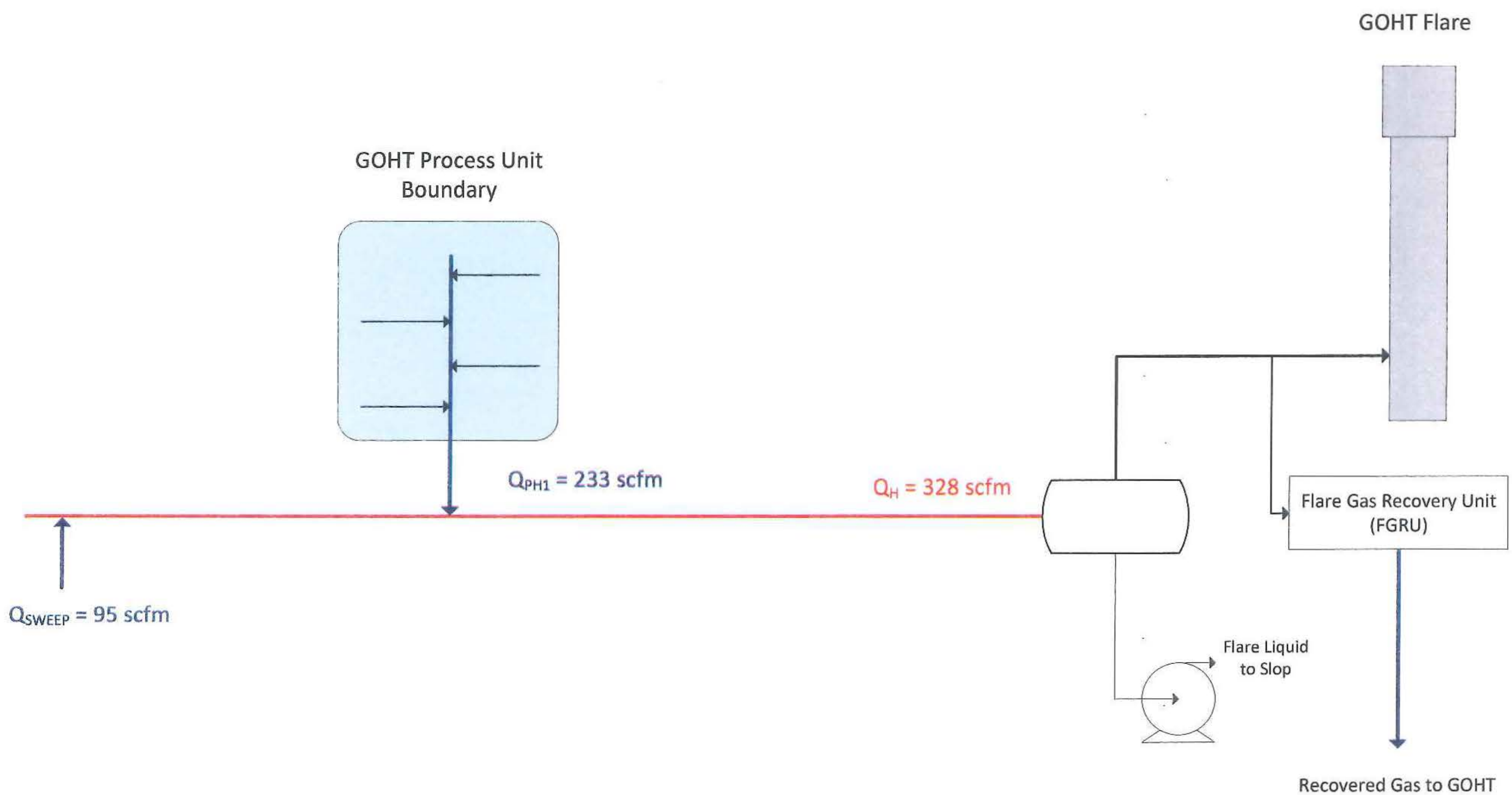
ATTACHMENT E
UIU FLARE WASTE GAS FLOWS


CRU Process Unit Boundary
NSU Process Unit Boundary
UIU Flare
Q_{PH1} = 73 scfm
Q_{PH3} = 165 scfm
Q_H = 962 scfm
Q_{PH2} = 204 scfm
Q_{SWEEP} = 520 scfm
Flare Liquid to Slop
ISOM Process Unit Boundary

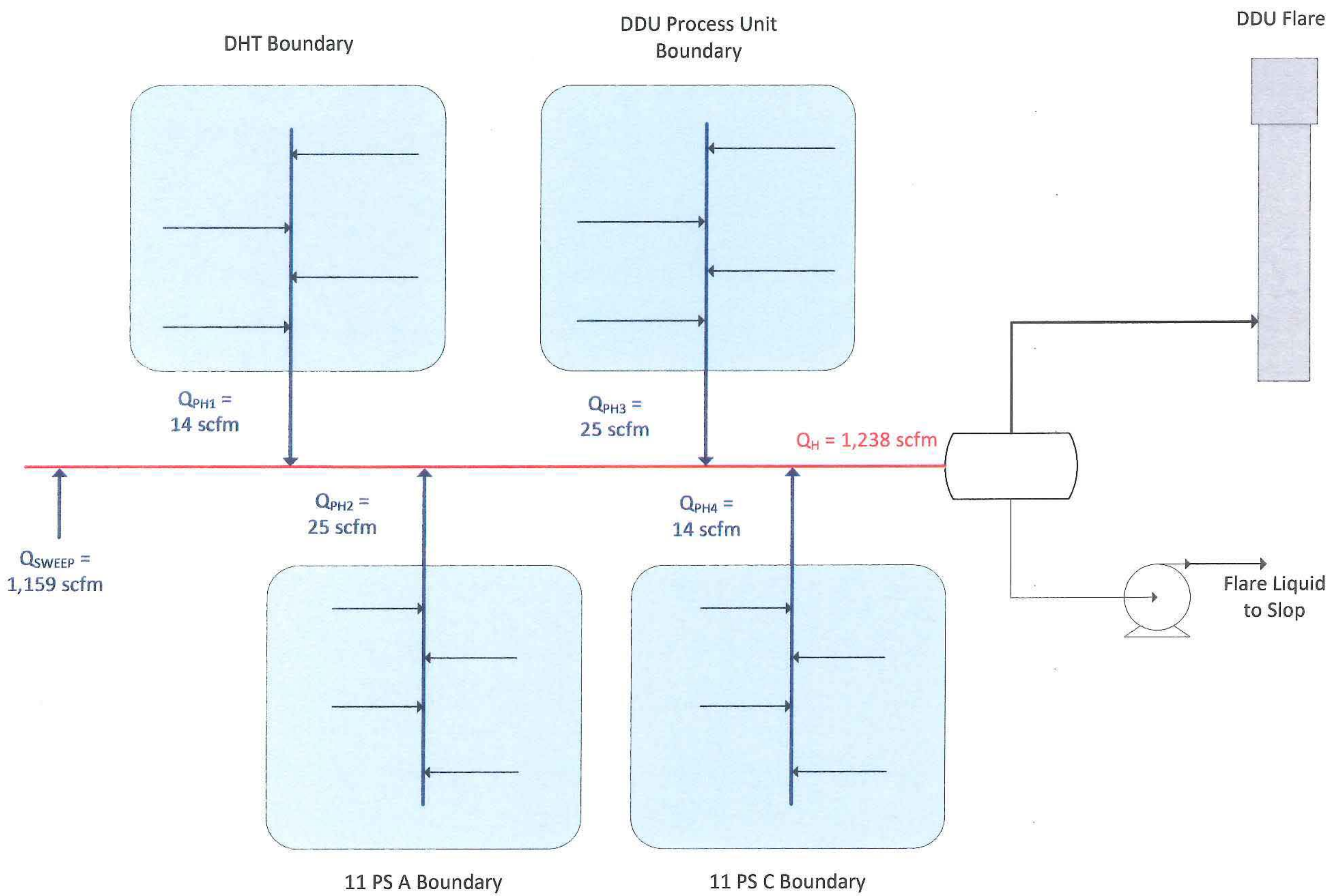
ATTACHMENT F
SOUTH FLARE WASTE GAS FLOWS


SOUTH Flare
No. 2 Coker/VRU 400 Process Unit Boundary
VRU 300 Process Unit Boundary
Q_{PH1} = 256 scfm
Q_{PH3} = 64 scfm
Q_{H} = 1,072 scfm
Flare Gas Recovery Unit (FGRU)
Q_{PH2} = 164 scfm
Q_{PH4} = 92 scfm
Q_{SWEEP} = 495 scfm
Flare Liquid to Slop
Recovered Gas to VRU 300
12 PS Process Unit Boundary
SRC Process Unit Boundary

ATTACHMENT G
GOHT FLARE WASTE GAS FLOWS


GOHT Flare
GOHT Process Unit Boundary
Q_{PH1} = 233 scfm
Q_H = 328 scfm
Flare Gas Recovery Unit (FGRU)
Q_{SWEEP} = 95 scfm
Flare Liquid to Slop
Recovered Gas to GOHT

ATTACHMENT H
DDU FLARE WASTE GAS FLOWS



DHT Boundary
DDU Process Unit Boundary
DDU Flare
Q_{PH1} = 14 scfm
Q_{PH3} = 25 scfm
Q_H = 1,238 scfm
Q_{PH2} = 25 scfm
Q_{PH4} = 14 scfm
Q_{SWEEP} = 1,159 scfm
Flare Liquid to Slop
11 PS A Boundary
11 PS C Boundary